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THE DAWN OF MODERN CHEMISTRY.

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THE period of the history of chemistry which I have chosen to designate as the dawn of modern chemistry begins practically in the early sixteenth century and extends well toward the latter part of the eighteenth century. Not that the chemistry of that period shows any very clear relation to the present state of chemical science, but because at about the middle of the sixteenth century there was inaugurated an era of activity in chemical thought and experimentation, which has continued with steadily increasing velocity and productiveness to the present time. The period referred to does not by any means mark the beginnings of chemical arts or theories, for the beginnings of the technical arts of chemistry may be traced back as far as recorded history. The earliest records of Egyptian or Babylonian origin show that the arts of metallurgy, the making of bronzes and other alloys, have been practised, and uninterruptedly so, since at least some 3,500 years before the Christian era. So also the manufacture of glass and pottery, the coloring of glass and pottery, the manufacture of colors for dyeing and painting, are of great antiquity. It is worthy of note also that these technical arts of chemistry possessed since very ancient times a kind of literature of their own in the form of recipes and directions for the various processes of the special art. Such manuscripts were doubtless not meant for public information, but for the use of the artisan alone, and were transmitted from the master to the apprentice or successor for his own use. The earliest original manuscript of this character known to exist is a manuscript on papyrus written in the Greek language which was discovered in an Egyptian tomb at Thebes, and is now preserved at Leyden. It dates from the third century of our era, and was doubtless a manuscript which escaped the wholesale destruction of alchemical and magical works in A.D. 290 by order of the Emperor Diocletian, issued, as believed, to prevent the danger of the possible making of gold by the alchemists and its resulting influence upon the

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currency system of the Empire. This work consists of recipes for the testing of metals, their purification, their alloying, making of bronzes and brasses, the coloring of metallic objects by superficial alloying, imitations of gold, writing in gold letters, preparation of purple colors, etc. Some hundred recipes in all are contained in this manuscript. It is evidently based upon earlier works of similar character, and indeed earlier works whose contents have been preserved to us through the mediation of copies or abstracts by later writers evidence that the ideas and methods were doubtless mostly centuries old when this papyrus manuscript of Leyden was written. The researches of scholars, notably of Berthelot, have shown how very similar, in many cases identical, recipes to those of the papyrus of Leyden have been transmitted through Roman, Arabic and later languages in manuscript form, probably uninterruptedly in Europe down to the beginning of the printing of books.

It is believed that the Greeks originally derived their knowledge of the chemical arts largely from Egypt, but that the ancient Greek philosophers were the first to divorce the philosophy of chemistry from the religious ideas and magical notions of the Egyptian priesthood which with them obscured the logical reasoning from cause to effect, or from effect to cause. However that may be, the Greeks were the first sources of natural philosophy for European thought. And such names as Thales, Democritus, Pythagoras, Plato and Aristotle are names that characterize the period of the height of clarity of Greek philosophy somewhere from about 600 to 300 B.C.

At about the time when this papyrus of Leyden was written the so-called Alexandrian School of Greek philosophers was dominant. This later period of Greek philosophy was marked by much brilliancy and genius, but was also characterized by a distinct influence from Egyptian sources of oriental mysticism and occult philosophy.

The Romans were the natural inheritors of Greek thought, and the Roman conquest of the civilized and much of the uncivilized world again operated to spread the useful arts of chemistry as known to the ancients, though Roman influence did not contribute greatly to generalizing thought.

In A.D. 489 the Alexandrian Academy was destroyed by the Emperor Zeno and its Greek scholars scattered. A body of these, mainly Syrians, established themselves in Persia, where they continued the study and teaching of the science of the Alexandrian school.

Barbaric invasion resulted in almost complete extinction of the remains of Greek civilization in Europe. The Syrians in Persia were the principal conservators of ancient science, and they continued to preserve and reproduce the works of the ancient Greek writers.

In the seventh century occurred the great Mohammedan conquest of the Mediterranean countries. The conquering Moslems overran

Persia and Syria. Fortunately they were impressed by the Syrian scholarship, and Syrian scholars were given place in the courts of the Caliphs, and such works of the science of the ancient Greeks as were in their possession were translated into Syriac and Arabic, and thus such authors as Euclid, Archimedes, Ptolemy, Hippocrates, Galen, Zosimus and Aristotle became accessible to Arabian scholars and served as the foundation to the science of the Arabians.

In the eleventh and twelfth centuries these Syrian schools were in their turn suppressed by Mohammedan fanatics and the Arabians themselves became the principal guardians of ancient science. Arabian translations of Greek authorities and the works of Arabian commentators, often translated into Latin, became the authoritative sources of medieval science. So completely indeed had the original Greek works disappeared from Europe that later centuries assumed that the Arabians were the originators of much that they merely acquired and transmitted from the ancient Greeks and Egyptians through Syrian and Arabian translations. Arabian physicians, astronomers, mathematicians and alchemists became the teachers of science to the Europe of the middle ages.

The original literature of the ancient world having practically disappeared from Europe during the early middle ages, science and philosophy had reached a low ebb. The medieval Christian Church was also discouraging in its attitude toward scientific discovery and philosophic reasoning. Clerical authorities and the scholastic learning became more and more intolerant of dissenting opinions or any kind of free thought. Stagnation in science was the consequence, especially in the natural sciences. In medicine, for example, experiment and independent observation hardly existed. The works of Avicenna, Averroes, Mesue and other Arabian interpreters of the Greek authors Galen and Hippocrates were the recognized authorities, and even in the universities of the fourteenth and fifteenth centuries, the teaching of medicine consisted in reading and expounding the works of these authors. The works of Galen and Hippocrates themselves were indeed hardly known in their original purity, but as elaborated with infusions of Arabian mysticism and superstitions, symbolism and astrology.

Other sciences exhibited similar tendencies. Astronomy had degenerated from the rationality of Pythagoras or of Ptolemy into a stereotyped Ptolemaism mixed with astrology. The doctrines of Aristotle as interpreted and corrupted by similar influences were the accepted natural philosophy. The condition of chemistry was similar. While mining, metallurgy and other ancient arts of chemistry maintained their continuity in spite of barbarian invasions or Mohammedan conquests, and gradually added to their store of useful facts, the generalizations or theories which have always been essential to great advances in science had deteriorated to a condition which might be

called rudimentary even as compared with the earlier chemical philosophy of Thales, Democritus or Aristotle. The early Greeks had at least reasoned logically from the limited knowledge in their possession. That their generalizations were often more metaphysical than scientific resulted from the fact that their deductions were not based so much on experiment as upon the observation of the more obvious natural phenomena. And, however valuable metaphysical reasoning may be for intellectual discipline, or as a tool in the critical analysis of observed phenomena and their relations, it can not go beyond the facts involved in its premises and can not materially advance the development of experimental sciences. Thus it is safe to say that up to the fourteenth or fifteenth centuries the natural and physical sciences presented few advances and much retrogression from the best days of ancient Greek science.

Arabian scholarship, however it may have contributed to mathematics, astronomy and certain fields of physics, had brought to chemistry little new of value and much of confusion of mysticism and superstition. This statement is largely justified by the results of modern critical investigation which have shown that the works of chemical character attributed to the authorship of Gheber, Avicenna and other Arabian authors are quite generally fabrications of the twelfth to fifteenth centuries, published under those names either to obtain a wider circulation or to avoid the unpleasant consequences that might visit the real authors for dabbling in a suspected or forbidden art. Just as the medical science of the early Renaissance was a medley of Greek Galenism, oriental mysticism and medieval superstition, so the chemical philosophy of the time was a medley of Aristotelian philosophy, with similar infusions of oriental occultism. Many chemical substances were known which to Greeks or Egyptians were unknown—but in so far as any valuable body of theory is concerned, hardly an advance had been made. The chemical theory of the time was mainly of Greek and Egyptian origin filtered, as we have seen, through the Syrian and Arabian sources and for centuries nearly without material progress.

Let me attempt to present the main fundamental concepts of the nature of matter and its changes which constituted the generally accepted chemical theory at the beginning of the sixteenth century, whence we date the revival of chemistry.

The ancient Greeks entertained a very persistent notion of the essential unity of matter. They differed at various times and in different schools of natural philosophy as to the formulation of this theory. Thus some considered that water was the primal element from which all others had been developed, others considered the air as the primal element, others fire. Aristotle finally formulated the notion of the constitution of matter which became the most generally accepted

theory in later centuries. This was the theory of the five elements—fire, air, water, earth and ether or essence. It seems very probable that this theory was derived originally from ancient Hindoo philosophy, because in ancient Hindoo classics it is more completely elaborated than by Aristotle. The four elements—air, fire, water, earth—were not considered as distinct elementary substances, according to our modern definition of an element, but rather as determining qualities.

Thus fire combined the qualities of warmth and dryness; air—warmth and moistness; water—cold and moistness; earth—cold and dryness. All substances were considered as combinations of these elementary qualities, or in some sense as composed of these elements. The fifth element, ether or "essence," was more subtle and less clearly defined. It was supposed to be capable of taking all forms, and finally came to be identified with the "materia prima," or primal matter, out of which all other forms of matter were supposed to be born.

The Aristotelian notion of the four elements also implied the possibility of the change of one element to another. Thus when water evaporated by heat it became air; that is, by the addition of warmth, it changed from *cold and moist* to *warm and moist,* the properties of air. This idea among later alchemists served to justify the notion of the transmutability of the elements, that will-o'-the-wisp of chemists for many centuries. But this idea of the possibility of transmuting one element into another as of the baser metals into gold and silver received greater vitality from the observations and experiences of the metallurgists upon the occurrence, preparation and alloys of the metals,

The metals known to the ancients were seven in number, gold, silver, lead, mercury, iron, copper and tin, though they were not considered as elements. Other metals indeed entered into their alloys, but they were not recognized by them as separate or distinct from those already named. Arsenic was known, though not considered as a metal. Bismuth and zinc and antimony began to be recognized as distinct substances about the beginning of the sixteenth century. As methods of analysis were rudimentary even at this later date, and as there was no realization of the concept of an element of unvarying composition and properties, and as the metals were obtained in varying degrees of purity or admixture, it can be understood how the changes in appearance and properties of the metals, as obtained from their ores, was believed to be due to a partial transmutation in the Aristotelian sense.

In the alloying of various metals, the character of the alloys was changed in ways that easily suggested actual changes in the character of the metals themselves. Thus we know that the Egyptians considered certain alloys of gold and silver as a distinct metal "electrum." The frequent occurrence of some gold in silver as obtained from its ores also easily suggested the idea that this gold had in some way been produced from the silver.

Hence, if by alloying certain metals they obtained a metal resembling gold in color, this was perhaps really an approach to making gold, and, if it had been possible to make such an alloy by any combination of materials as should answer all their known tests for gold, from their standpoint it might well be real gold.

We can comprehend that if we considered an element only as a combination of certain qualities and not as a specific simple substance—there would be no a priori improbability in such an hypothesis.

Thus the experience of the chemists with the metals was the real motive force in vitalizing and in modifying the ideas of the Greek philosophers with respect to the nature of matter and its changes. The attempt to imitate precious stones was another line of work which helped to confirm these theories, though it may well be doubted whether in all cases the alchemists were self-deceived as to their success in producing the real articles even when they succeeded in passing them off as genuine.

Nevertheless the accepted theory of the essential unity of matter and of the possibility of transmuting one element or substance into another was the working hypothesis that kept the alchemists, for so many centuries, at their vain labors. As the study of the metals and their uses formed so large a part of chemical activity, there also grew up in time special theories as to the origin and changes of metals. One of the oldest of these can also be traced to the Egyptians and to Plato—the notion that mercury bears a peculiar relation to the origin of the metals. Among the Egyptians lead occupied a similar position, but the substitution of mercury in this rôle took place as early as Plato.

The very peculiar properties of mercury—argentum vivum, the liquid living silver, quick-silver—and the strange manner in which it lost its identity in combination and in alloys with other metals gave rise to a theory that it was the source of the other metals. And again, as with other metals, it might not always be the same in composition and properties, the idea developed that not the ordinary mercury, but a mystical purified mercury—the so-called "mercury of the philosophers" was a constituting element in all the metals.

So also sulphur bore a prominent relation to the occurrence and to the furnace reactions of metallic ores. Its combustibility, its frequent presence in metallic ores, the combinations with metals and the colors of these combinations—the red or black of its mercury combinations—the black copper compound—the yellow or red of arsenic compounds—etc., endowed it also with a mysterious relation to the metals, and it also became considered as a constituting element of the metals. Arsenic, which acts very similarly to sulphur in many such compounds, was sometimes associated with it in that rôle. And here again was assumed not ordinary sulphur, but a fancied perfect sulphur—the "sulphur of the philosophers."

Again the seven metals were associated with the seven planets of the ancients—gold with the sun, silver with the moon, copper with Venus, lead with Saturn, iron with Mars, mercury with Mercury, tin with Jupiter, and these planets were supposed to exert influences upon the generation and development or perfection of the metals in the earth. The base metals were often supposed to be undergoing a gradual development toward perfection. This development toward perfection, that is, toward silver and gold, might be influenced by many factors, such as the relative quantities of their sulphurs or their mercuries, the relative purity or degree of perfection of these mercuries or sulphurs, the time and local conditions of their position in the earth and the influences of their planets. It was not considered improbable that chemists might by experiment devise means to hasten this natural growth.

These notions I believe fairly summarize the quite generally entertained theories which make up the representative chemical theory at the beginning of the sixteenth century. But this beginning of the sixteenth century is the period of the full flower of the Renaissance. The first impulse to this period of remarkable activity in all domains of human thought originated in Italy, and at least as early as the thirteenth century. It began with a renewed interest in ancient Greek and Roman literature and art, naturally also a fresh interest in philosophy. It was fostered by the Florentine Academy under the protection of the Medici, though its influence soon spread to other parts of Europe. A new spirit of criticism was awakened, and even the church was invaded by a long-forgotten stimulus to freedom of thought and discussion. As the movement spread, the aroused interest of men in all domains of human activity gave rise to many great movements. In the thirteenth century were founded the universities of Padua, Bologna, Salerno, Salamanca, Paris, Montpelier, Oxford and Cambridge. Some of these trace their foundation to clerical schools of even earlier date—but grew to importance and influence under the new impulse.

In the fourteenth century the German universities of Vienna, Prague and Heidelberg were founded, and the fifteenth century was marked by a rapid increase in the number of German and French universities and in their influence. An influence of similar importance to that of the universities of the time—and perhaps even surpassing that influence—arose from the invention of printing from movable metal types which occurred about the middle of the fifteenth century. The revival of interest in ancient literature as well as the promulgation of new ideas was vastly stimulated by the possibility of making written works accessible to a vastly increased constituency, and the interchange of information and ideas thus made possible contributed enormously to the great intellectual development which we call the renaissance. The

civilized world became stimulated to new thoughts and to new enterprises, one might almost say it became intoxicated with great ideas and great ventures.

Natural science was the last field of thought to feel the new impulse, and in chemistry there was little evidence of progress until the sixteenth century. The representative chemical authors known to the fifteenth century were Arnald of Villanova, the unknown writers who wrote under the name of Raimundus Lullus (or Lully) and unknown writers who wrote chemistry under the name of Gheber, or of Albertus Magnus. All these writings were obscure in style and contributed little to the knowledge of chemistry or to clear thinking. The chemists of the period might be classified into two groups—artisans who were not generally of university education, working by traditional methods in their respective arts and not addicted to writing or philosophizing; and the learned class, usually physicians, sometimes clericals. Some interest in chemistry existed but was mainly confined to the efforts to discover the transmutation of metals or the elixir of life. Chemical facts were at times developed by their efforts, but disappointments and disillusions had brought the chemical theories of the ancients and alchemists into general stagnation and disrepute. Cornelius Agrippa, writing about 1530, quotes a proverb of the time—"An alchymist is either a physician or a soap boiler."

Four men notably mark the beginning of a new era in chemical activity, Theophrastus von Hohenheim (called Paracelsus), Georg Bauer (called Agricola), Vannuccio Biringuccio and Bernard Palissy.

Paracelsus was born in Switzerland in 1493; Agricola in Saxony in 1494; Biringuccio of Siena, Italy, probably about the same time; while Palissy was born in France and his birth year is variously given as 1499 and 1510.

We can better appreciate the stimulating intellectual atmosphere of the period in which these men lived if we recall that the span of their lives touched the life times of Michelangelo, Macchiavelli, Leonardo da Vinci, Ariosto, Rafael, Rabelais, Copernicus, Vesalius, Thomas More, Columbus, Cortez, Cardanus, Martin Luther, Erasmus and Savonarola.

Three of the four chemists mentioned—Agricola, Biringuccio and Palissy—may be said, each in his own line and country, to have laid the foundations of modern chemical technology. Each of them wrote an almost epoch-making work in a particular field of applied chemistry and exerted a powerful impetus toward raising the profession of technical chemist above the rank of Agrippa's "soap-boiler."

Biringuccio's work was published in 1540 in Italian under the title of "Pirotechnia." It treats of the metals, the semi-metals, their ores and minerals, and of some salts; of the alloys of the metals, their manufacture and uses. It contains also recipes for the use of the goldsmiths, the potters and other artisans. It is important as an

attempt to give a sober, sensible and intelligent description of the technical chemistry within his knowledge. It is interesting also because it preceded the greater work of Agricola by about sixteen years and is mentioned by the latter as having been in his hands, though it contained little that was of use to him.

While Biringuccio is known only through his one book, the works of Agricola are more numerous. They are chiefly upon minerology, mining or geology. He began publishing about 1530, but his great work, "De re Metallic," appeared in 1556. Agricola was a man of university training, and a scholar of fine type. He had studied in Italy and was a physician by profession. He was city physician at Joachimsthal in Bohemia, and later at Chemnitz in Saxony. His location in these mining centers gave him ample opportunity to become interested in mining and mineralogy and in the chemical operations used in metallurgy and assaying. The great work above referred to is for the time a very remarkably clear description of the operations of mining, smelting and assaying, with very complete description of the chemistry of these arts as known to the miners of the time and region. He does not claim apparently to have contributed original work to these arts, but the work of Agricola may justly be considered as the first really great work in the line of the scientific presentation of a chemical industry, a worthy pioneer to the many great technical works which have since appeared in so many lines of chemical industry. Its influence in its own field was immediate, as shown by the later editions called for and even still more by the number of similar though less important treatises which followed its appearance.

Bernard Palissy was a man of much less scholarship than Agricola. What he lacked in that respect he compensated for in an unconquerable enthusiasm in experimentation in the field which most interested him—the making of pottery and its glazes and enamels. He was a real investigator in his field, and his published works describe his experiments and discuss them clearly with neither the dogmatism nor the mystical jargon that most chemical writings of the previous centuries, or even of the subsequent century, exhibit. His works published between 1557 and 1580 may be said to have done much the same for the arts of the potter that the work of Agricola did for mining and the chemistry of metallurgy, with the difference that Palissy's work was rather a presentation of the result of his own labors than a complete compendium of existing knowledge and practise as was the "De re Metallica."

It can not be claimed either for Agricola or for Palissy that they were free from the prevalent superstitions or mystical ideas that were almost universally entertained in their century—but it can be asserted that they kept their constructive labor and thought free from obstruction from such notions. Both repudiated the transmutation ideas of the alchemists as vain and profitless, and both endeavored to make their

knowledge and their ideas as comprehensible as possible for their successors or contemporaries. Theirs was the spirit of service and that is also the spirit of modern science.

The work of these three chemists, however scientific its spirit and method, was not such as to affect immediately the thought of the time in lines outside of the industries they represented, nor to influence the chemical notions of the university faculties—mainly interested in philosophy and medicine.

The fundamental basis of chemical theory of the middle ages—the rudimentary chemical philosophy of the Greek-Arabian philosophers and alchemists—was not seriously affected by the work of these pioneers.

It is to Paracelsus that we are indebted for the impetus that was to inaugurate a broader and livelier interest in chemical activity and in chemical theories. Paracelsus was a man of very different type from his three colleagues already mentioned. A physician by training and profession, as his father was before him, he had traveled much and far—from Sweden to Italy, and from France to Bohemia—as an army surgeon, student or itinerant doctor. Brought up in childhood and in early manhood in mining countries, he had early become interested in the chemistry of the metals and had himself worked in the laboratories of the mines. He was a man of original power, restless activity, great energy and a natural-born revolutionary.

The early influence of philosophers of the fantastic neo-platonic natural philosophy of the Florentine Academy and its followers, had shaken his faith in the accepted Aristotelian and Galenic philosophy which was the basis of medical theory and medical teaching of the time. This revolt from the traditional dogmas, combined with manifestly acute powers of observation and an open mind for such medical or chemical practises or ideas as he met with in the course of his extensive experiences among all classes of people in many lands, resulted apparently in enabling him to surpass the conventionally restricted medical practise of his time in the successful treatment of many diseases. His reputation as a brilliant and able physician attracted early the notice of some of the noted scholars at Basel—and Paracelsus was called to that city as city physician and professor in the university. In his teaching he at once began opposing the conventional dogmas and the antiquated practise of medicine. The history of medicine and the testimony of learned critics of the period such as Erasmus, Agrippa, and Peter Ramus give ample evidence that the time was ripe for a reform in medicine. For centuries all initiative had been discouraged by the accepted infallibility of the traditional Greek and Arab authorities. The medical practise was based on analogical reasonings, and astrology, charms, incantations and exorcisms played an important part. To question the foundations of the medical theory or to introduce innova-

tions in medical practise was unpardonable heresy to the guild of physicians.

Paracelsus must be credited with the ability to appreciate the failings of the profession and with courage and ability with which he addressed himself to the task of breaking down the wall of inertia and tradition behind which the medical profession had entrenched itself. In this task he found but scant assistance from within the fold. On the contrary, he soon aroused the liveliest animosity and the most bitter opposition on the part of medical faculties. But opposition did not discourage him. His was the spirit of the propagandist and the fanatic, and antagonism and persecution but intensified the earnestness and the energy with which he labored for the spread of his revolutionary doctrines. That he might appeal to a wider constituency than the hostile academically trained profession, he followed the example of Martin Luther in discarding the use of the Latin language in lectures and writings, and wrote and spoke in his native German. This was also a flagrant offense against professional etiquette and helped to widen the breach between the medical schools and Paracelsus and his pupils and followers.

Irritated by the attacks of his colleagues, he retorted by publicly burning the Canon of Avicenna, as Luther had burned the papal bull, and similarly to show his contempt for the assumed infallibility of the ancient authorities of medicine.

The lines of attack of Paracelsus upon the medical doctrines of his time were mainly three. First: Not the authority of the ancient authors, but observation and experiment must serve as the basis of medical diagnosis and treatment. Second: The substances of the human body are chemically constituted, the processes of the body are chemical processes and hence chemistry must form one of the foundations of rational medicine. Third: The use of the complex mass of decoctions of rare and costly herbs which served as the basis of the Galenic physicians' practise was not founded on reason, but on superstition. In his view every medicinal plant or mineral has an essential principle or spirit and to find and purify these and to apply them to the cure of diseases is a worthy and important aim of chemistry.

Many interesting and valuable improvements in medical practise are attributed to Paracelsus, but it is not the early history of medicine that interests us here except as it is involved with the development of chemistry.

The works of Paracelsus were apparently written between 1526 and his death in 1541, and therefore were written before the publication of the work of the three chemists above mentioned. They are, as collected, a voluminous mass and of heterogeneous character, medical, surgical, philosophical, chemical and theological.

In harmony with his notions of the value of chemically prepared

medicines he introduced into the practise many remedies not authorized nor sanctioned by the medical schools. Preparations of antimony, iron, mercury and opium were prominent among these, and apparently were employed with success in his own practise. To the chemists he especially appealed to abandon the vain search for the making of gold and silver—"the threshing of empty straw"—and to devote their energy and skill to the preparation of new remedies, and to their application to medicine.

But few of the works of Paracelsus were printed during his lifetime. In several cases the reason for this can be directly traced to the opposition of the medical faculties and their influence upon the public censors or publishers. But he did not cease writing on that account, and some twenty years after his death there began the active publication of his manuscripts. Some of these were autograph manuscripts—others more or less complete copies, or lecture notes edited or expanded by former pupils—some of doubtful authenticity, and others known to be fabrications published by anonymous writers. It is still difficult in many cases to be certain as to the authenticity of some of the many treatises attributed to him. Their popularity and influence during the succeeding century was very great, as is evidenced by the fact that the Paracelsus bibliography by Sudhoff enumerates no less than 390 titles of printed publications up to 1658, when the last and best known Latin edition of his collected works made its appearance. Among these were four editions of his collected works in German and two in Latin.

Through the mass of writings of Paracelsus are scattered, rather than systematically gathered, the chemical facts and theories which comprise his contribution to chemical literature. Together they form a considerable body of chemical knowledge, descriptions of chemical processes and substances known in his time with much of speculative theory. There is no evidence that he added in any important way to the chemical knowledge of his time. Though the first announcement of some chemical facts appear in his writings, he makes no assumption of originality in their announcement, any more than do Agricola and Biringuccio in their works. It was rather by his evident familiarity with the chemistry of his time, and the novel and radical application of chemical preparations in the practise of medicine, that he challenged the attention of the chemists of his time. Here his influence was epoch-making. In the field of chemical theory he shows greater originality, and while much of his speculations are fantastic in the fashion of the philosophy of the time, yet in other directions he exerted important influence.

One very influential contribution to chemical theory, however, is to be attributed to Paracelsus. This was the theory of the three principles—the "tria prima." It will be remembered that the early alchemists had recognized the peculiar relation of sulphur to the occur-

rence and changes of the metals—the sulphur of the philosophers—and similarly with respect to arsenic and mercury. Upon these vague and variously formulated hypotheses Paracelsus founded his more consistent theory.

All matter was, according to Paracelsus, constituted of three principles, sulphur, mercury and salt. Sulphur, he explains, is that which burns—the principle which renders bodies in any degree combustible and yielding heat. Mercury was that principle of bodies which renders them liquid or volatile, which enables them to melt on heating or to pass off as a vapor by distillation or volatilization. Salt was the principle which resists the action of heat—the ash or the non-combustible and non-volatile constituents of matter. It will be observed that this is a generalization of the properties of substances based upon the observation of their behavior towards the various degrees of heat to which they were subjected in the customary processes of roasting, distillation, ignition or reduction (this word also we first find in Paracelsus).

The doctrine of the three principles of Paracelsus possessed that advantage over the Aristotelian elements—fire, water, earth, air—in that it was more closely related to experiment and experience and not so purely metaphysical. It could serve as a kind of working hypothesis to help understand the results of chemical experiment. The *tria prima* received early recognition in chemistry. The very celebrated work called the "Triumphal Chariot of Antimony," written about 1600 and passed off on the public as a translation of an early manuscript by an alleged Benedictine monk, Basil Valentine, adopted and helped to give a wider circulation to this theory. It became almost universally accepted by the chemists of the seventeenth century, and such popular text-books as those of the French chemists, Christopher Glaser and Nicholas Lemery, placed it at the foundation of chemical theory (the latter as late as 1713).

In the latter part of the seventeenth century, Becher introduced a variation of this theory, by placing, instead of sulphur, a terra pinguis, as the combustible constituent, fat or oil having, in so far as its combustibility is concerned, a similar behavior to sulphur—for mercury and salt he substituted a terra mercurialis (mercurial earth) and a terra lapidis (or stony earth),

This in itself was no advance, but Becher's pupil, Stahl, and his followers elaborated this sulphur of Paracelsus or terra pinguis of Becher into the idea of a more abstract heat substance, phlogiston, while the less useful hypotheses of the mercury and salt gradually disappeared.

In the eighteenth century under the influence of such able chemists as Scheele, Black, Cavendish and Priestley the phlogiston theory became the most inspiring theory to stimulate the observation and researches of chemists. Only at the close of the eighteenth century when the

phlogiston theory was no longer adequate to explain all known facts were the facts it attempted to explain re-interpreted by the genius of Lavoisier in terms of the modern theory of oxidation and reduction.

In considering the value and influence of all these now abandoned theories, we should keep in mind that the value of a theory in science at a particular epoch depends not so much upon its absolute truth or reality as upon the extent that it assists in classifying and accounting for observed facts and in stimulating to new observations or experiments.

It will be seen how the above theories are linked together and how each served for its own century and prepared the way for its successor. Nevertheless, the greatest service which Paracelsus contributed to the development of chemistry was in the influence which his teaching and his example and his widely published works exerted in battering down the wall of infallible dogma that for centuries had protected the doctrines of medicine from any important development from the side of its relation to chemistry. His unceasing criticism of the defects of the theory and practise of the ancient authorities, his trenchant arguments for a broader experimental basis for the science, his severe arraignments of the ignorance and venality of the physicians of his time; his ridicule and defiance of their sacred authorities, together with the constant reiterations of the knowledge of chemistry as essential to understanding the life processes in health and disease, exerted a powerful influence not indeed so much upon the university faculties or the physicians schooled in their doctrines as upon the younger and more progressive generation of students. Also his appeal to the chemists as such to find in the future of medicine a field of endeavor more promising of success than the as yet unrewarded efforts for the transmutation of the base metals into gold, found much following among those who were interested in the study of chemistry. If we recall that most of the scholarly trained chemists were also physicians, we can understand how this combination of medical and chemical aims advocated by Paracelsus found fertile soil among young physicians and medical students as among chemists of less conventional training.

That this is true is shown, not only by the tremendous vogue of his printed works, but also by the fierce contest which for a century split the medical profession of Europe into hostile and embittered factions of Paracelsists and anti-Paracelsists—adherents of the new chemical medicines and advocates of the older Galenic remedies.

While the greatest service of Paracelsus was to shatter confidence in dogmas revered for the sake of their authors' great names, the new doctrines which he set up to replace the dogmas he combated were, in many respects, as fantastic and unscientific as the earlier ones. Nevertheless, the shattering of the blind faith in traditional teachings, which gave to Paracelsus his popularity and following, necessarily operated also to prevent his new doctrines from becoming considered as sacred

or infallible. Free criticism and independent thought once aroused could not again be contented with blind adhesion to any unchanging system of doctrines.

Very naturally the period of chemical activity following the shattering of long-accepted dogmas was characterized by many wild and fantastic notions. Many of the most extravagant claims of alchemy and of marvelous medical nostrums are found in the literature of the latter part of the sixteenth and of the first half of the seventeenth century. But much was done, on the other hand, in developing chemical facts. Men like Van Helmont and Glauber, while retaining much of the mysticism and obscurity of Paracelsus and earlier chemists, yet contributed in no unimportant way to the constructive work of adding to established chemical facts as the result of their experiments, though indeed contributing little of permanent value to chemical theory or generalization. Chemists were generally either adherents of the Aristotelian elements, or of the three elements of Paracelsus, according as they belonged to the conservative or radical parties. Nevertheless, there was much independent speculation and theorizing, though rarely on a scientific basis. The new freedom found expression in extravagances of ignorance and superstition, in charlatanry and imposture, as well as in much earnest and valuable labor. But at all events, chemistry was now, at last, very much alive, and the mission of chemistry was at last recognized as of importance and dignity. Werner Rolfink, professor of anatomy, surgery, botany, medicine and chemistry at Marburg, is said to have been the first officially recognized professor of chemistry in Germany—A.D. 1629. A chair of chemistry was established early in the same century at the University of Paris, and a Scotch physician, William Davisson, was the first incumbent. In 1635 he published a text-book on chemistry for the use of his students, a work which passed through many editions.

The University of Leyden is credited with the first chemical laboratory at a European university, and the distinguished De la Boe Sylvius was the professor of the theory and practise of chemistry as well as of medicine. He was a strong adherent of the chemical medicines. Other early university laboratories were at Altorf, 1663, Stockholm, 1683.

Thus was beginning to be realized the ideal so confidently maintained though vaguely realized by Paracelsus, of exalting the study of chemistry and recognizing its importance in the development of medical science. How important the interrelation of these two sciences was to be in our day revealed, not even the imagination of Paracelsus could have dreamed.

As Paracelsus in the sixteenth century gave the first important impulse to the development of modern chemistry, so, in the middle of the seventeenth century. Sir Robert Boyle may be said to have inaugu-

rated a new epoch in chemistry by his remarkably sane and sound criticisms of the chemical thought and theories of the time. Boyle was a broadly and thoroughly trained scholar of the time, and prominent in many lines of activity. He was one of the founders of the Royal Society of England and at one time its president. He was also a man of wealth, but his main interest was in experimenting in chemistry and physics, and many notable observations stand to his credit. Every student of chemistry or physics knows of Boyle's law of gases.

It is not, however, by his experimental work—valuable as it was—that he exerted the greatest influence, but rather by his extended and frequent careful and scientific criticisms of the prevalent chemical theories, both the Aristotelian and Paracelsan theories, of the nature of substances and matter. Particularly by his work published in 1661 entitled "The Sceptical Chymist," in which, rather verbosely, but with great thoroughness and yet with great tolerance and patience, he submits the theories of the time to really constructive criticism. By a wealth of facts and experimental illustrations he demonstrates the purely metaphysical character of both the prevalent theories, and gradually develops the only consistent concept of an element which was possible for his time—namely, any substance which no experimental evidence could show to be reducible to simpler substances. He makes indeed, no attempt to say that any particular known substance is indeed an element in the sense of his characterization, though one might infer from his discussion that gold and silver were as well deserving of the title as any substances known to him, as he has never been able to obtain anything else from them or to know of any reliable experiments with such results. Unlike Paracelsus, or Glauber, or Van Helmont, or their imitators, Boyle was no dogmatist, being slow to assert and yet open-minded to any facts and very respectful to the opinions of others, though not in the least dominated by them.

The "Sceptical Chymist" of Boyle, as well as others of his writings, had a very wide circulation throughout the continent as well as in Great Britain, and his sane and persuasive reasoning, free from mysticism, and based on legitimate inferences from observed facts, made a great impression upon scientific men. While he offered no theory to replace the discredited Aristotelian and Paracelsan theories of the constitution of matter, he transferred the emphasis of chemical thought from *a priori* speculation to rational deductions from observed phenomena, and, though these might often be imperfect or mistaken, yet chemical reasoning was launched upon a course which could only lead to clearer understanding and to more soundly established theories.

The century following Boyle may be well characterized as the phlogistic period, because the representative chemists of that period were largely occupied in systematizing chemical actions with reference to that theory.

The fundamental notion of this theory was, as we have mentioned, a development from the combustible and heat-giving sulphur of Paracelsus to the notion of a heat substance, phlogiston, which constituted a part of all combustible or, as we should say, oxidizable substances. The phenomena of combustion or oxidation were in terms of this theory due to a loss of phlogiston—the phenomena of reduction to a gain of phlogiston. It is just to say of this theory that it proved a fertile and valuable hypothesis to the science of chemistry in developing a vast amount of excellent experimental work and of comprehensive generalizations. We have only to recall the names of Scheele, Priestley, Marggraf, Black and Cavendish to realize the class of chemists whose labors were influenced and stimulated by the adoption of this theory.

Two serious obstacles to continuous progress were, however, inherent in this theory. The supposed phlogiston could not be separated or isolated and weighed. It could not be known whether it had a positive weight in combination, or whether it could affect in any definite or determinable way the weight of other substances. It might even have the effect of buoyancy or of diminishing the weight of substances with which it was combined, and so long as such ideas were held the weights as given by the balance could not be depended upon to give the real quantitative relations of chemical reactions.

The second obstacle this theory offered to chemical development lay in the fact that so long as this theory was maintained no identification of substances as elements was possible. Boyle had given us a proper definition of an element, but so long as such oxidizable substances as phosphorus, sulphur, iron, zinc or carbon were considered as combinations of phlogiston with other substances (viz., their oxides) and so long as the products of combustion, such as we now know, as the oxides of phosphorus, sulphur, iron, etc., were considered as products of the loss of phlogiston, and therefore to that extent simpler or more nearly elementary than the combustibles from which they were produced, it is manifest that the elementary character of most of the known elements could not have been recognized. It required the insight of Lavoisier to discern the real nature of combustion and reduction, and to banish at last the element phlogiston from the weighable factors of chemical reactions.

But with this period of chemistry, the dawn of modern chemistry was past and the sun was shining brightly above the horizon.

THE FLORAL FEATURES OF CALIFORNIA

By Dr. LeROY ABRAMS

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SHUT off from eastern North American by the high Sierra wall, that formidable barrier to the eastern and western migration of plant, as well as animal life, and possessing a climate unlike that of any other part of the continent, California has developed a flora that is unique. Indeed, isolation has been so complete that the California flora, with its host of peculiar or endemic species and even genera, displays many qualities characteristic of an insular flora, such as one might expect to find on a remote oceanic island. To the traveler familiar with the flora of the Mississippi Valley or of the Atlantic States, California plants seem as foreign as those of southern Europe. Species of such well-known genera as *Quercus, Prunus* and *Rhamnus* (the oak, the cherry and the buckthorn) are so unlike their eastern relatives in foliage and general aspect that their true relationship is revealed only on close scrutiny.

But if the Sierra wall with its snow-clad summits has been an effective barrier to the eastern and western migration of plants, it has been likewise effective as a pathway for the southern migration of northern plants. And the warm valleys and foothills that lie at its base have been similar pathways for the northern migration of southern types. We find, therefore, the California flora composed of three distinct elements, the Californian, the Boreal, and the Mexican.

The Californian element, as recently discovered fossils prove, was established before the Glacial Period, and through its preservation from the destructive ice sheet, California has been able to hand down such a priceless heritage as the sequoias, an all but extinct race that at one time flourished over North America, Europe and Asia, extending as far north as Greenland and Spitzbergen. With the sequoias have come down many other conifers, making the California coniferous forests the richest in the world.

The Boreal or northern element, pushed southward by the ice sheet of the Glacial Period, formed a belt on the California mountains below 5,000 to 8,000 feet, the perpetual snow line of the ice age. At the end of the period, the ice retreated upward and northward, followed by the boreal plants, with the result that we now have arctic and subarctic species stranded on mountain tops a thousand miles or more south of their general range.

The Mexican element has migrated, largely since the Glacial Period,

from the south through the desert and Great Basin regions following increased aridity. The great Mexican Plateau was the original home of most of the strictly American genera now found throughout arid and semiarid western America. On this plateau a drought-resisting flora existed in the Miocene age, when the greater part of the United States from the Atlantic to the Pacific was covered with a rich deciduous forest, comprising such trees as the beach, elm and magnolia—a type of flora that still persists in the southern Atlantic States.

The rôle played by climate in California has augmented that of isolation. Without its peculiarities and diversities the rich and varied California flora would never have been evolved. California climate is lauded the world over. Yet the term means little and is misleading as it carries the impression of uniform climate. Naturally within a state extending through more than nine degrees of latitude, 769 miles, one would expect to find considerable difference in the temperature of the northern and southern sections, with a corresponding difference in vegetation. But add to this range of latitude diversity of topography with its marked influence on rainfall, temperature and atmospheric humidity, and we have a complexity of climates and climatic influences that are astounding—literally scores of climates sufficiently distinct to influence profoundly the character of the vegetation.

Temperature, one of the most important factors governing plant distribution, ranges from the perpetual snow fields of the mountains to subtropical valleys where killing frosts are scarcely known. Bordering the snows of the high Sierra such boreal plants as the dwarf arctic willow, cassiope, bryanthus, primulas and fringed gentians, flourish, while in the subtropical sections, the lime, the olive and the pomegranate are grown, and even the more sensitive though less poetic banana and alligator pear. Everywhere the African pelargoniums, the "geranium" cherished by the eastern housewife and tenderly nurtured within her furnace-heated house, runs riot, growing into good-sized shrubs and frequently used for porch coverings or hedges. The castor bean, described in all botanical text-books as an annual, here becomes a tree living for years, and grown for ornament and shade. Between these two extremes, boreal and subtropical, are all the intermediate zones; the cool temperate, where rye, red currants and apples flourish, and the warm temperate with the almond, apricot and fig.

But great as is the range of temperature and its effect on vegetation, rainfall and atmospheric humidity are fully as varied and play even a more important rôle over a large part of the state in determining the character of the vegetation. The normal annual rainfall in certain localities of the northwest coast region runs nearly to one hundred inches. At San Diego, also on the coast, it is only a little over nine inches. On the deserts, lying east of the mountains which have robbed

the prevailing winds and storms of their moisture, the normal rainfall is seldom over five inches and often less than two.

With such a complex of climatic conditions it would be futile to attempt an account of the numerous plant associations or formations. We shall rather try to present some of the general features of the most important floral districts or belts.

The Coniferous Forests

California possesses the richest and most unique coniferous forests in the world. Nowhere is there the wealth of species and genera, nowhere such giant trees or interesting and rare types. Within the state there are thirteen genera and forty-eight species, twice the number found in the territory covered by Britton and Brown's "Illustrated Flora," an area over six times that of California. But it is not so much the variety of kinds that makes these forests famous as it is the grandeur of the individual trees, and the unique character or scarcity of the species.

The Giant Sequoias or Big Trees are world-renowned for their immense size and great age—the oldest and largest living beings. Here, in their Sierran fastness, these giants stand majestic, vigorous and sound to the heart—trees that were centuries old when Christ was on earth. In the words of their first warden, the venerable Galen Clark,

> **their majestic graceful beauty is unequalled. . . . The bright cinnamon color of their immense fluted trunks, in strong contrast to the green foliage and dark hues of the surrounding forest, make them all the more conspicuous and impressive. In their sublime presence a man is filled with a sense of awe and veneration as if treading on hallowed ground.**

They are distributed along the western slopes of the Sierra Nevada at middle elevations for a distance of about two hundred and fifty miles. Toward the southern end of their range extensive forests are formed and reproduce freely; but north of Kings River the groves are small and isolated, comprising middle-aged or mature trees with few or no seedlings. These isolated groves are thought to represent the original patches which escaped the destructive onslaught of the ice age. The average height of the large specimens is about two hundred and seventy-five feet, although trees three hundred and twenty-five feet have been measured. The diameter of the trunk averages about twenty feet, but a few trees attain thirty, and the General Grant is said to be forty feet at the much-enlarged base.

The Mariposa Grove and the smaller Tuolumne and Merced groves are within the Yosemite National Park. In addition to these, two other parks have been established by the Federal government for the preservation of the giant sequoia, the General Grant National Park, situated in the Kings River forest and the Sequoia National Park, in the Kaweah River forest.

INLAND BORDER OF THE FOG AND REDWOOD BELTS, Photographed by Robinson and Crandall.

Associated with the giant sequoias are to be found some of the best specimens of other Sierran conifers. Of these the sugar pine is the most magnificent. It is the king of pines. It attains a height of two hundred to two hundred and twenty feet, with a bole eight to twelve feet in diameter and often eighty feet to the first limb. The huge cones eighteen to twenty-six inches long hanging pendent from the tips of the widely spreading branches are a striking feature that marks the sugar pine as far as the eye can see.

In the redwood (*Sequoia sempervirens*) the giant sequoia (*Sequoia gigantea*) has a strong rival for first honors. The redwood is the highest known tree, the giant sequoia the greatest in diameter. Comparatively they stand about three hundred and fifty to three hundred and twenty-five feet in height, and twenty-two to thirty feet in diameter. The redwood is more abundant than the giant sequoia, and in the Humboldt forests it forms magnificent stands of timber from which over one million feet of lumber have been cut from one acre.

The distribution of the redwood is an excellent illustration of the delicate balance held between vegetation and climatic environment. It forms a distinct belt along the coast ranges of central and northern California, never extending inland more than twenty or thirty miles and conforming with striking significance to the coastal fog belt. The heavy summer fogs that frequent the coast ranges of central and northern California lower the temperature and increase the atmospheric humidity. Furthermore, the minute fog particles are collected on the forest trees and precipitated to the ground. The writer has tramped through fog in midsummer chilled to the marrow, with the trail muddy and slippery wherever it passed beneath a tree. Indeed, so great was the precipitation of the fog by trees that little rivulets formed and ran several yards down the mountain trail. Fifteen minutes' walk away the hot August sun was shining on a road inches thick in dust. Here were climatic differences as great as those of England and Spain.

Associated with the redwoods, but of more extended range are a number of other trees of special interest. The tanbark oak (*Pasania densiflora*) is the only representative in North America of that large Asiatic genus. Its acorns resemble those of an oak, but the staminate flowers are in dense erect catkins as in the chestnut, and with the same disagreeable odor. The California laurel, the only member of the genus *Umbellularia,* is a beautiful evergreen tree with smooth dark green lance-shaped leaves that emit the odor of bay. The madroñe (*Arbutus menziesii*), with its smooth polished trunks of a rich mahogany color, is one of the most striking trees in the California forests. It has attractive foliage of large, smooth, glossy, oval leaves, and bears open clusters of deep red berries that persist until Christmas.

In addition to the great forests of the Sierra Nevada and the red-

wood forests of the northern coast region, there are, usually in remote isolated spots, a number of other conifers especially interesting on account of their extreme rarity. All these species, which are far more local and rare than the giant sequoia, are situated in the coastal region. They are supposed to represent an ancient flora that existed here when the coast ranges formed an archipelago some distance off the western shore of the continent.

The Torrey pine is the rarest pine in the world. It is found only in two small groves of scattered trees, one a few miles north of San Diego, and the other on the eastern end of Santa Rosa Island. San Diego has wisely acquired the mainland grove and established a park in order that these trees might be preserved.

The Santa Lucia fir inhabits the Santa Lucia Mountains, an isolated range lying along the coast between Monterey and San Luis Obispo. This fir is found nowhere else, and is distinct from all other firs in its sharp-pointed leaves and bristly cones. It is within the Santa Lucia National Forest and is therefore assured protection.

Both the Monterey cypress and the Monterey pine are found on the Monterey Peninsula. The pine forms a forest over a large part of the peninsula and extends down the coast for fifteen to twenty miles. There is also a grove on the coast of San Luis Obispo County and another a few miles north of Santa Cruz. The cypress is confined to two small groves situated on the two promontories that mark the boundary of Carmel Bay, just south of Monterey. Here, perched on the high cliffs overhanging the Pacific and buffeted by winds and storms into picturesque, often grotesque attitude, they add a Japanese touch to the charms of this coast, famed as the most beautiful spot on the Pacific. We are constrained to say that both of these groves are under private control. Cypress Point, the more accessible of the two, is in the hands of a self-styled "Improvement Company," and as we write word comes that it is to be surveyed into lots and thrown on the market. May public-spirited citizens do their utmost to acquire and preserve this unique grove! Surely it will be to our everlasting shame if California permits the destiny of these, the rarest of all trees, to depend upon the whims of summer cottagers.

Foothills and Valleys

Much of the peculiar charm of California lies in her rolling foothills and broad fertile valleys, purple-rimmed by mountains. Here are great stretches of the beautiful valley oak, with its massive spreading crown sometimes nearly one hundred feet across. To quote Dr. Sargent, the best known authority on American trees:

No other region in the world presents anything to compare with its park-like beauty, the nobility of the individual trees, or the charm of the long vistas stretching beneath them.

It is in the valleys and foothills that the typical California flora is seen in its full glory. Here poppies and buttercups, creamcups, tidy tips, yellow pansies, sun cups, yellow forget-me-nots, berries and bush mustard throw a gorgeous mozaic of mingled yellows over the coast meadows. In the open foothills, fields covered with splendid splashes of the wonderful gold of the poppy and the deep blue of the lupine, broken in spots by the gray green of the oak, spread out like a huge impressionistic canvas. On gentle slopes of sandy loam, escobita, cousin of the gaudy Indian paint brush, stretches out into a velvety carpet of old rose.

Typical also of the California flowers are the many varieties of bulbous plants curiously adapted to the California climate by their deep-seated bulbs that lie dormant through the long dry season, sending up their foliage leaves in early spring and their flower-stalks at the end of the rainy season. In the open fields and country roadsides the mariposa tulips, coming after the showy spring annuals, display large open cup-shaped flowers, delicately painted as a butterfly's wing. Brodiæas, some with open, others with close clusters of blue hyacinth-like flowers, greet one everywhere. Mission bells, mysteriously invisible, stand solitary tall and erect in the open woods, delighting their discoverer with drooping bell-shaped flowers mottled with bronze and green. Fairy lanterns, exquisite little plants of graceful form and delicate coloring, grow half concealed among the grasses of the open woods and rock ledges.

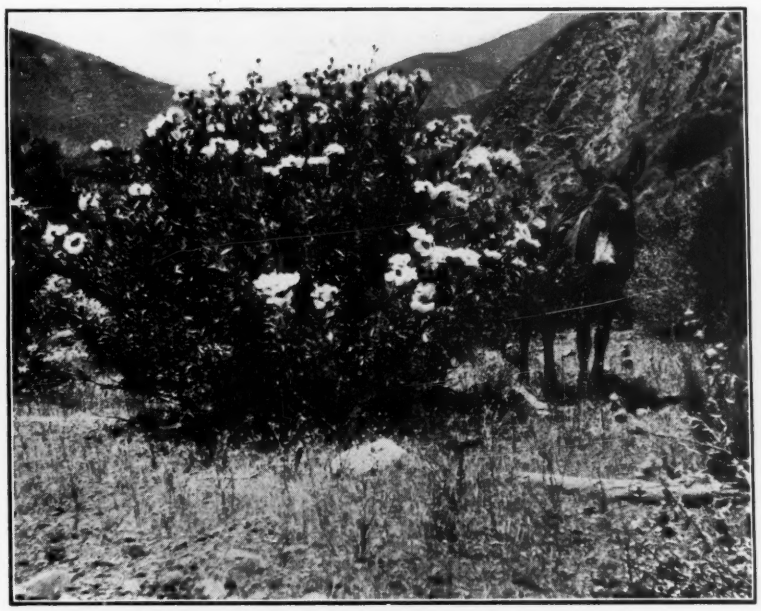
The advent of the white man has greatly changed the aspect of the vegetation in the valleys and foothills. Not only have vast fields of showy annuals, chaparral and noble oaks given way to orchards, vineyards and grain fields, but many of the open, untilled foothills are now covered with wild oat, bur-clover or filaree, southern Europeans, brought over by the Spanish padres and spread broadcast by nomadic bands of sheep, which at the same time wiped out forever many a delicate native annual.

The Chaparral

On dry gravelly hillsides, especially on southern exposures, and in the valleys where the soil is light and the water-table below the reach of roots, drought-resisting shrubs abound, forming dense, impenetrable thickets known as chaparral. These shrubs are evergreens with short, stiff, often spinescent branches and small, thick, leathery leaves of a dull gray or olive green. The level mass takes on a somber monotonous tone. But in blossom time, manzanitas with their tiny urn-shaped flowers of a delicate pink, lilacs forming masses of blue, lavender or white, garrya, with its long, pendant, soft gray catkins that have won it the name of "silk-tassel tree," the ever-present chamise, a peculiar rosaceous shrub with the foliage of the heath and spiræa-like clusters

of small white flowers, the chaparral pea, mountain mahogany, bush poppy and yerba santa, all lend a charm that compensates for the long periods of gray monotony.

The preponderance of shrubs is a striking characteristic of California. One familiar with the shrubs of the eastern states will discover many surprises among the California varieties. To be sure, he will find many familiar genera, such as roses, currants and snowberries, but many strangers as well, such as the shrubby poppies, phloxes, mallows, monkey-flower, and even senecio. His solitary bear berry, uva-ursi, is here represented by about twenty species and New Jersey tea by over



THE MATILIJA POPPY IN EARLY JUNE, photographed by the writer.

thirty, many of which are very attractive in bloom and appropriately named California lilac.

In southern California the wild buckwheat, the laurel-leaved sumac and the black and white sage are prominent along the lower edge of the chaparral. The buckwheat and sages are bee plants par excellence, and produce tons of clear white honey. The Spanish-bayonet, a member of the yucca family, is widely distributed through the chaparral. Most of the year it is merely a tuft of dagger-like leaves, but in May and June each tuft sends up a straight flower-stalk eight to twelve feet high, bearing a huge pillar-like mass of creamy white flowers that may be seen for several miles. On canyon floors one will occasionally meet the matilija poppy. This is California's most gorgeous flower. It grows in round clumps eight to ten feet high, bearing a profusion of delicate

crepe-like flowers, five to eight inches across, pure white in color with a rounded mass of yellow stamens in the center.

The Deserts

To transcontinental travelers the deserts are bleak, forbidding wastes, the very antithesis of life, and are passed with a shudder. But to him who follows their shifting trails with burro and pack saddle they open up a new world; animals, plants and the very rocks wholly unlike those of his well-trodden paths through fields and meadows. He may travel for days over the desert without meeting a familiar plant, no conifers, no oak, nor rose, no buttercups or violets. Plants, instead of spreading out broad green leaves to the friendly sunshine, protect themselves from the withering rays of a burning sun by casting off their leaves and forcing their twigs and branches to carry on their work, or by reducing the leaves in size and covering them either with wax, as does the creosote-bush, or with a dense layer of impervious cuticle, as does the desert holly, or with a gray mat of soft down, as do some of the daleas. Others, as the cacti, store up water in their thickened fleshy stems. Still others, members of the gourd family, develop enormous roots for water storage. Pondering on the significance of all these strange types, the wonderful adaptations, the development and modification of structures to meet these severe tests of endurance, one stands amazed at the powers of nature, realizing as never before the vital force of climatic environment.

Low, straggly shrubs of subdued tone and thorny cacti are the common plants of the desert. Of these the most universal is the creosote-bush with its waxy leaves, bright yellow flowers and all-pervading odor. Along living streams grow willows and cottonwoods, but desert trees are few in number. Where a little moisture is permanently retained, mesquit, palo verde and ironwood may be found. In the Mojave Desert the most striking feature is the yucca, which forms weird, fantastic groves scattered orchard-like over many square miles, the Joshua tree of the early Mormon settlers. On the western rim of the Colorado Desert, fringing the base of the southern California mountains, are several groves of the desert palm. An especially fine group is in Palm Cañon, splendid trees with straight, unbranched trunks eighty to one hundred feet high, crowned by great tufts of spreading fan-shaped leaves and clothed sometimes nearly to the base with withered leaves that lie pendant along the sides in great thatch-like masses. Here is a veritable Saharan oasis, and there eight miles away and ten thousand feet above, stands the summit of San Jacinto, harboring typical arctic plants around its lingering patches of snow.

Such are the contrasts of California.

A HISTORY OF FIJI, II

By ALFRED GOLDSBOROUGH MAYER
THE CARNEGIE INSTITUTION OF WASHINGTON

UPON the death of old Tanoa, his son Thakombau (evil to Mbau) became Vunivalu. He was an ambitious, energetic, crafty and intelligent man, but the problems of government were becoming yearly more complex in Fiji.

Missionaries had entered the group in 1835, and although Tanoa did not permit them to live in Mbau or to attempt to make converts of his subjects, other chiefs welcomed them, for they brought valuable presents and increased the importance of those among whom they lived. Gradually other white men had come to Fiji. At first mere degenerates or deserters from vessels who lived as did the natives themselves, but afterwards men of more ambition and intelligence gathered to the shores of these distant islands, and assumed a leading part in affairs. The missionary influence was beginning to be felt, for converts were being made among the lower orders of the population, and the power of the native priests, and with it that of the chiefs was weakening.

Vainly did Thakombau rail against the advance of civilization, for the hated power of the Mbau chief, founded as it was upon terrorism, was doomed. One after another defeats came to the war parties of Thakombau, and so reduced was he at last that, the missionaries being the sole power left to whom he could appeal for aid, he was forced in 1854 to profess Christianity, and cannibal feasts were known no more at Mbau. It was a great triumph for the missionaries, the result of nineteen years of unremitting toil amid constant dangers and surroundings unspeakable in horror.

That Thakombau's conversion was forced upon him as a matter of expediency is evident, for in a speech he called upon the gods of Fiji, saying that he still respected them as of old, but that the time had come when he must add the white man's god to those of his ancestors.

In the days of his power he had owned a fleet of more than a hundred war canoes, manned by a thousand warriors. 15,000 subjects acknowledged him as king, and in addition half of Fiji paid him tribute or admitted his supremacy, and he had boasted that the cannibal ovens of Mbau never grew cold. He had more than fifty wives, and he himself knew not how many children, and when but a child he had wantonly murdered one of his playmates; yet he had but to declare himself a Christian and hundreds of his subjects followed the chief's example

as Fijian custom demanded. Indeed, even to-day whenever a high chief stumbles and falls all in his neighborhood must tumble like checkers in a row, and, if he takes medicine, his subjects clamor for some of the same sort.

We must not assume that all or even that most of the Fijians were hypocrites in thus following their chief. For years the zealous spirit of the missionaries had been at work among them and they had gained the hearts of many of the poor and downtrodden, especially of the women, upon whom the tyranny of savage days fell with a heavy hand. It was the high chief and the warrior classes who had most to lose through the levelling democracy of Christianity which denied their divine right to rule through tabu, abolished their polygamy, discouraged war, prohibited cannibalism and in every way lessened their authority and rendered ridiculous the proud traditions of their caste. While the high chief remained unconverted, the missionary's lot was happy in that he well could be the kind and simple friend of the distressed and the brotherly adviser of the troubled, but with the conversion his temporal power became paramount, for it was impossible for him to escape the difficult double rôle of leader in secular as well as religious affairs, and thus the simple-minded lover of mankind was suddenly exalted into the position of the vicar of the terrible god of the white man whose favor was hard to win and whose punishments were eternal.

It is but fair to the missionaries to recognize that their temporal power was at the outset forced upon them, and that the mistakes which they have at times fallen into are those which overshadow the spiritual function of the clergy in all states wherein the government has fallen under the domination of the priesthood.

It was indeed fortunate for Fiji that the missionaries had been obliged to labor for nineteen long and almost hopeless years, and to endeavor in every way to understand and endear themselves to the people before any of the important chiefs had yielded to their teaching.

Everywhere in the Pacific where missionary success was quickly and easily attained, results more or less disastrous to the natives had followed. Despite many notable and glorious exceptions such as Chalmers of Papua, the old type of missionary was too often predisposed to regard all customs not his own as "heathen," hence pernicious. Thus if success was immediate, as in Hawaii, his well-meant zeal impelled him too quickly to overthrow old customs and at once to force upon his converts a semblance of the habits of his own stratum of European society.

In this connection it should, however, be said that the blame for most of the bigotry, which has been all too evident, especially in former times, should fall but lightly if at all upon the field worker who, living among the natives, comes to love them as his friends and at least deals with

them as individuals; but the fault lies chiefly with the home boards, who, not realizing the paramount importance of local conditions in treating with primitive peoples, have attempted to enforce almost the same set of regulations from Greenland's icy mountains to Africa's coral strand.

The missionary, whether he would or no, is forbidden to conduct marriages between heathen and Christians, and too often one party to the contract must enter upon it with a lie upon his or her lips. The hypocrisy and espionage which results from sharing with the informer, or the chief, the fines derived from those who smoke, or swear, or work upon a Sunday, may well be imagined, and moreover, altogether too large a share of the earned wealth of the natives is demanded from them, the revenues of the church in certain groups being decidedly larger than the taxes collected by the civil government.

Yet let us not blind ourselves to an appreciation of the fundamental good the missions have accomplished, for whether Christianity be true or false, the natives must live under the rule of a people actuated by its motives and its faith, and are thus through its acquisition inestimably better fitted to resist the evil that preys upon them with the advent of "civilization."

In Fiji, however, the natives had become thoroughly known to the missionaries before the great conversion of 1854, and many old customs were thus permitted to remain which would have been suppressed had the missionary, and the political *party* which inevitably springs up around him, came more quickly into power.

The *power* of the missionary, after the great chiefs cast in their lot with him, is indeed terrible for good or evil, and in Tonga and later in Fiji he connived at the arming of the natives in order to *conquer* "converts." As the struggling priest of a great religion the missionary inspires all respect, but as the crafty politician or bigoted inquisitor his actions become correspondingly reprehensible. Too often in those early days of missionary endeavor he seemed satisfied with a mere semblance of order and religion for this was the period in which faith rather than good works was deemed essential. To the natives he too often remained one of a foreign race—a wizard, terrible, mysterious and implacable. Happily, a change has come over the thought of the world, and the conditions we describe are not those of to-day.

Henceforth Thakombau was to remain nominally king in Fiji, but the real power was vested in the white men who had settled upon his shores. He had escaped the retribution of native revenge only to struggle hopelessly in the net of commercialism and diplomacy. It was a sad and disappointing period between the time of the conversion in 1854 and the annexation to Great Britain in 1874. Soon after Thakom-

bau "lotued"[3] in 1854, a powerful faction in Mbau rebelled and fled to Rewa where they arrayed themselves under the banner of the great chief Ratu Quara or Tui Dreketi (the Hungry Woman or the Long Fellow), a famous warrior and an implacable enemy of Thakombau who threatened to destroy Mbau and to kill and eat its king in revenge for the burning of Rewa in 1847. At one time only a single Tongan and a missionary guarded Thakombau in his house at Mbau, but, at this critical juncture, an American ship under Captain Dunn arrived and, aided by the missionaries, Thakombau and his party were enabled to purchase guns and ammunition. Rewa might still have conquered, however, had it not been that Ratu Quara died of dysentery in January, 1855.

Indeed, as the Reverend Mr. Waterhouse states, the people of Mbau grew to hate Christianity after Thakombau had professed it to be his religion. The Fijians had a highly developed system of constitutional government, which varied somewhat with the locality, but was nowhere an absolute despotism. In fact the influence of unprincipled white men and the introduction of firearms led to conquests which had done more to exalt the power of a few chiefs and to develop the worst excrescences of the social and religious system of Fiji than had any other factor.

At Mbau there were two high chiefs, the head priest of Roko Tui (the reverenced king) who was above all in rank and was held in religious veneration but took no part in war or political affairs; and the Vunivalu (root of war), the executive head of the tribe. Upon the death of the Vunivalu, his successor was elected from among his relatives by the land-owners and chiefs of the tribe, and should he fail to carry out their policy they refused to provide him with food.

After white men came and the lust for conquest overpowered all else at Mbau, their ancestral veneration for the Roko Tui declined, and the Vunivalu became correspondingly more powerful. Thus Thakombau was not the Mikado but the Tycoon of his people.

But to return to the historic narrative: King George Tubou of Tonga, the most powerful Christian convert in the Pacific, came to the aid of Thakombau in 1855, and for the moment reestablished his supremacy, but at the same time he acquired a knowledge of Thakombau's weakness, and became convinced that a Tongan conquest of Fiji was possible.

For generations the Tongans had been in the habit of sailing to Lakemba, Kambara, and other islands of the Lau group in Fiji, where the forests afforded large trees for the making of canoes. A year or more would be employed in canoe building, and thus the newcomers had

[3] Assumed the waist-cloth which the missionaries obliged all converts to wear.

learned Fijian customs and acquired an interest in the political affairs of the islands. Finally they began to overrun and conquer the Fijians and were the cause of much disorder and distress.

In about 1848 a powerful rebellion headed by Maafu the cousin of the Christian king broke out in Tonga, but was suppressed by George Tubou. Maafu, its leader, was exiled to Fiji and it was intimated to him that if he desired a kingdom it was his to conquer.

Of the highest Tongan birth, young, ambitious, of superb physique, energetic and in every sense a leader among men of action, Maafu came to Fiji and at once became the ruler of all Tongans in the group.

His policy was to assist the weaker Fijian chiefs at war with stronger enemies, and then the combined Tongan and Fijian army having been victorious, he would turn upon his erstwhile allies and overpower them. Thus he gained a foothold at Vanua Mbalavu and from this as a base he proceeded to conquer the Fijis. As Seeman says in his account of his Government Mission to Fiji:

> Where Maafu and his hords had been it was as if a host of locusts had descended.

Famine and poverty stalked in his wake, yet wherever he went there was a Tongan "teacher" by his side; and, as Seeman says,

> the Wesleyan missionaries were kept quiet by Maafu making it the first condition in arranging articles of peace that the conquered should renounce heathenism and become Christians.

There is a strange silence in missionary accounts respecting Maafu, for not once does his name appear in Calvert's "Missionary Labors among the Cannibals" published in 1870, yet he added hundreds of "converts" to their flocks, and the Tongans and missionaries remained upon the best of terms; and only after the treacherous and brutal torture and massacre of prisoners at Natakala[4] and Naduri were the missionaries forced by outraged public opinion to wash their hands of Maafu and join weakly in the protest against Tongan cruelty. It seems almost incomprehensible that this sad and revolting abuse of power should have been exhibited by the missionaries in the part they took in conniving at native warfare in Tonga Tahiti, and Fiji in order that their reports to the home mission might "glow with the glorious story of conversions."

By 1858 there were but two great chiefs left in Fiji, Maafu and Thakombau, and the two powers were face to face. Doubtless the missionaries would have had their own way more readily with Maafu, for when they had suggested to Thakombau the abolition of the old system and the establishment of a "constitutional monarchy," he had

[4] See William T. Pritchard, 1866; Polynesian reminiscences, pp. 225–234. London.

answered "I was born a chief and a chief I will die." Nevertheless he was finally forced into yielding to the demands of the white men. Thus Maafu "the Christian" would doubtless have conquered Mbau and become king of all Fiji had not Thakombau in 1858 signed a deed of cession granting his possessions to Great Britain. The British consul, William Pritchard, Esq., and a warship came to his aid, and Maafu was checked; and although the negotiations with England came to nought, the increasing immigration of Europeans to Fiji made native warfare more and more infrequent. Maafu had to content himself with only a partial realization of his ambition and in 1882 he died a disappointed man. Had he commenced his operations five years sooner, he would have become the conquerer of Fiji. It was the hand of Great Britain, not that of the missionaries, that had checked his blood stained career.

The affair which caused Thakombau most serious trouble appears to have been one of those extortions which have been so frequently perpetrated by a "civilized" upon a simple people. On July 4, 1849, the residence of a whiter trader named Williams, then serving as United States consul in Fiji, was burned and the natives stole some of the furniture and stores while the house was in flames. Thakombau does not appear to have been personally responsible for the firing of the house, but the natives of Mbau in which the incident occurred were subject to him, and Williams demanded from Thakombau about $3,000 as indemnity. Upon the king's refusing to pay, the consul's demands were gradually increased and other claimants appeared, so that finally, having secured the cooperation of the United States government, the sum of $45,000 was demanded. Utterly unable to meet this "indemnity," harassed at home, and threatened from abroad, it seemed to simple Thakombau an intervention of Providenece when certain money-lenders from Australia offered to pay the claim of the United States in consideration of the deeding to them of 200,000 acres of the best land in Fiji. It may well be imagined that only for a brief moment was his kingly head allowed to rest in peace. Poor Thakombau, and with him all Fiji, had indeed fallen "into the hands of the Jews," and it was a happy moment when, on October 10, 1874, he signed a document which read, "We, King of Fiji, together with other high chiefs of Fiji, hereby give our country, Fiji, unreservedy to her Britannic Majesty, Queen of Great Britain and Ireland. And we trust and repose fully in her that she will rule Fiji justly and affectionately, that we may continue to live in peace and prosperity." Never was the confidence of a poor and degraded people better requited by a rich and civilized one, for a strong, and generous hand had come to rule in Fiji and the light of a happier day dawned upon the oppressed. Sir Arthur Gordon (afterwards Lord Stanmore) was the first British governor. He had

witnessed the cruelties of the disastrous native war in New Zealand, and knew full well how difficult it is to graft a European civilization upon a Polynesian stock. Fortunately there were high-principled men to whom he could turn for advice, and he did well in seeking the councils of Mr. John Thurston, long a resident in Fiji.

The annual poll tax of £1 per man and 4s. per woman which Thakombau's government had imposed was working ruin and death in Fiji. It was impossible for the natives to earn so large a sum, but the white planters eagerly paid the taxes and then "indentured" the wretched creatures, who were forced to work upon the plantations of their white masters at a wage so low that they toiled for 280 days in the year simply to repay the tax which the planter had paid to the government. Thus were the Fijians being entrapped into a bitter and unnatural bondage more merciless than the orgies of the worst period of cannibal days.

But Sir Arthur Gordon and Mr. Thurston soon tore loose the shackles of the slaves, despite the angry protests and threats of the whites in Fiji. Their plan was that each district be obliged to maintain a garden of copra, cotton, candle-nuts, tobacco, coffee or other produce, or to supplement this by the manufacture of mats or other articles of trade, and at the end of each year the products were to be sold under government supervision to the highest bidder and any money received over and above that of the district tax was to be returned to the district itself and divided among the taxpayers. This simple plan, which closely accords with their ancient manner of raising tribute, has encouraged industry among the natives, shielded them from the avarice of traders, secured to them their lands, and each year produced a sum considerably in excess of the taxes.[5]

Excellent as this plan was, it remained deficient in one important respect, for the government made no effort to establish manual-training schools wherein old crafts might be improved and new ones developed. Education in Fiji has been confined to religion and the "three R's," and inspiring as it is to witness the son of a cannibal extracting cube roots and solving quadratic equations, one inclines to the opinion that the prodigy's future life would be better assured of a career of useful service to the world and of happiness to himself had he been taught to be a good carpenter, mason, farmer or decorator. It is certainly unfortunate that, having ingeniously created a market for the products of Fijian labor, the English failed to improve the earning capacity of the natives, thus losing an unique opportunity to stimulate an interest in the useful arts that might soon have obliterated the apathy of the downcast race.

[5] Recently some of the districts have been permitted, subject to consent of the Governor, to pay their tax in money.

Mr. Thurston, the originator of the new system of taxation, had come to Fiji as a common sailor before the mast, but he lived to be Governor of Fiji from 1888 to 1896, and died as Sir John Thurston, universally beloved by the race for whose uplifting he had contended so courageously and well, and thus in Fiji there live to-day the happiest, the most law-abiding and potentially the most nearly civilized natives in the Pacific. It is one of the very few instances wherein a powerful and enlightened race have studied and toiled through many unrequited years to lift to a happier level a poor and barbarous people.

There is no longer in Fiji that painful contrast of which Wilkes complained between the beauty of the island scenery and the character of the inhabitants, for consistently in all respects the archipelago is now one of the fairest spots within the tropic world.

Nowhere in the Pacific did old customs change more slowly under European rule than in Fiji, for it has been the consistent policy of the British government to leave unaltered all that was good in the manners of old days.

The villages are almost as they were before the white man came, only the log stockades and the encircling moats have disappeared during the long years of peace, and the houses are no longer perched upon the summits of ærie cliffs, but now cluster along the river-banks or under the cocoa palms of the seashore. The high-peaked Mbures or temples, once such a picturesque feature, have fallen into decay with the advent of Christianity, although one thinks they might well have been preserved, enlarged and converted into Christian churches, for the tasteful sennit patterns which adorned their beams and rafters would have made the chapel the most attractive house in the village instead of being, as it too often is, a cheerless barn-like structure, ill-proportioned without and barren within.

The better types of native houses are set upon artificial embankments of stones and earth, sometimes twenty feet high, as in the valley of the Rewa River, where floods may be expected. The framework is of tree fern or cocoanut logs, ingeniously lashed together, and the sides and roof are covered with a thick thatch of wild cane, or cocoanut leaves spread over ferns. The roof is quite thin at the peak, but is fully a foot and a half thick at the eaves, where it projects slightly, and is cut off squarely, presenting a very neat appearance. The ground-plan of the house is usually rectangular, not oval at its ends, as in Tahiti, and the peaked roof has a long ridge-pole which projects several feet beyond the eaves and, if the residence be that of a chief, is thickly studded with white *Cypræa* cowrie shells, and sometimes other cowrie shells are strung upon ropes of cocoanut fiber sennit and hung pendant from the projecting ridge-pole. There are no windows, but several openings serve as doors and may in time of rain be closed with mats.

The floor is covered with several layers of pendamu mats, and a raised dais at one end of the single room serves as a bed and may be screened by mosquito-proof curtains of masi (tapa). A rectangular earth-covered depression serves for the fireplace and the smoke escapes as best it may, the smoldering embers imparting always a pleasant aroma to the air.

In speaking of everything Fijian, we must remember that the peoples of the Ra, or western islands of the Archipelago, and of the mountains, are of purer Papuan stock and are more primitive than those of the Vititonga race of the Lau group and the eastern coasts of the large island. Accordingly, the houses differ in different places, being smaller, more crudely and flimsily made among the Papuan than among the Vititonga tribes. Also in the western parts of the large islands and in the Ra islands, the chiefs are not so highly respected as among tribes whose blood has been mingled with the aristocratic Polynesian. At Mbau, the Roko Tui was almost god-like in native estimation, whereas in the mountains of Viti Levu the chief was only the leading councilor of the tribe, and labored in the fields in common with his subjects. Indeed the Mbau chiefs looked down upon those of the western part of Viti Levu, calling them Kai-si (peasants).

If the house were that of a high chief, as at Mbau or Rewa, the roof-beams were wrapped with interlacing strands of cocoanut fiber sennit, displaying a pattern in rich browns, black and yellow, so pleasingly contrasted that one is forced to regret that work of such high artistic merit should be suffered to remain in a house as inflammable as a haystack. Yet these houses withstand a hurricane far better than do the hideous corrugated-iron-roofed structures of Europeans.

Several old wooden basins, yaqona bowls, are hung upon the wall, their naturally dark wood coated with pearly blue where many a brewing of the drink has stained them. Carved war-clubs and long elaborately decorated spears may be seen suspended from the beams, and as the eye becomes accustomed to the dim light one beholds such treasures as a sperm whale's tooth strung as were old-fashioned powder horns upon a rope of cocoanut fiber and polished through repeated rubbings with cocoanut oil until its surface is as brown as tinted meerschaum. A few fly-brushes, pandamus fans for awakening the fire, a huge ceremonial war-fan of palm-leaf, some wooden food bowls, and crude cooking pots of fire-baked clay, and a clock that never goes, complete the list of the furniture. Yet one thing of painful memory one would fain have overlooked—the universal pillow. This consists of a block of wood or stick of bamboo supported upon legs so that it stands horizontally four or five inches above the floor. In old days when the hair was most elaborately dressed and trained into a huge mop, this pillow was doubtless a necessity, but in this shaven and shorn period of

Chrisianity such an instrument of torture might well be dispensed with, although by the native it is still regarded as the acme of luxury.

Housekeeping is simple in happy Fiji, where all is charmingly clean, and thick layers of soft mats invite repose upon the floor. Indeed the natives sleep much by day, for at night there is apt to be a "meke," wherein the maidens of the village, adorned in garlands of flowers and well polished with cocoanut oil, sing far into the small hours, keeping time to their chants by graceful gestures. This, together with the dull beating of the wooden drum, drives all hope of sleep away, but it is to be preferred to the "silent" nights when rats and mice scamper ceaselessly over the floor, contesting their supremacy with an occasional centipede or land crab. Yes, one must live a life of leisure and sleep by day in Fiji.

The largest edifice in the village is called the "stranger's house" for it is here that guests are entertained and fed by the community under orders from the chief. At Mbau the old stranger's house has stood for generations, dating far back into cannibal times, and within its walls the first Christian service was held in 1854. It is about 125 feet long and 40 feet wide, being exceeded in length only by the stranger's house at Rewa.

Carpenters are a highly respected caste in Fiji, and canoe and house building are occupations fit to engage the activities of chiefs. When one desires a house, a whale's tooth or other suitable gift should be presented to the chief, who then engages the carpenters, who in turn may command the services of more than two hundred assistants, all of whom labor so efficiently that in from one to three weeks the house is erected and ready for company. In the South Seas things are done in communal fashion and village labors, such as house building, canoe making, and the gathering of crops are occasions for songs and dances and all manner of merriment and feasting.

There is much of interest in Mbau, for although the ovens have long ago grown cold, yet the great foundation stones of the old temple of the war god (Na Vatani Tawake) still remain in the center of the village, and in 1898 one could still see the sacred tree upon whose boughs were hung the genital organs of victims who had been sacrificed to the Fijian Mars.

Close by the side of the foundation of the old temple a sharp-edged column of basalt is set upright within the ground. This is the stone to which victims were dragged by their arms and upon which their heads were dashed. Fragments of human teeth might still be found by digging at the base of this stone, and in many a house in Mbau there were sail needles made from leg-bones of the victims. There was another execution stone which was axe-shaped and thrust upright into the ground near the foot of the hill; but this now serves as the baptismal font, and is set within the church. The ovens in which victims were

cooked upon the hillside lay near this stone, as were also the great hollow log-drums, the "publishers of war" whose rolling beat the cannibal call in old days, and one of which now serves to summon worshippers to church.

An interesting trophy of old days was the anchor of the French brig *Aimable Josephine* which now lies close to the side of the foundation of the temple. This vessel was treacherously cut off at Mbau on the night of July 19, 1834, her captain and most of the crew being murdered. Native wars were waged over the possession of this trophy, the final resting place of which is Mbau.

The corner posts of the house of old Tanoa were still to be seen, and when natives pass these in the night they pluck green leaves and cast them upon the earth, for beneath the ground by the side of each post and embracing it with his arms there stands the skeleton of a victim who was buried alive.

The abutment of the sea wall of Mbau with its made-land, and docks built of large flat stones, is a remarkable example of native engineering, being surpassed only by the canal of the Rewans near Nakelo. Huge canoes, some of them with bows studded with white *Cypræa* shells, lie stranded here and there. The native houses are scattered over the made-land and along the gentle slope at the base of the hill, leaving the summit barren as of old, although here overlooking the city stands the residence of the Methodist missionary, and the graves of Tanoa and of Thakombau, the latter of whom died in 1883.

But exceeding all in interest was Ratu Epele Nailatikau, high chief of Fiji, son and successor of king Thakombau. Unreconciled to the presence of the white man, his memories harked far back to old days and beams covered with woven sennit, and in its treasures of old days, when his family were great and all-powerful in Fiji. Yet, though shorn of power, no king could have been treated with more respect by those around him than was he.

His house in Mbau was a small one, in no way differing from those of the lesser chiefs, excepting in the richness of its Taviuni tapa screens, and beams covered with woven sennit, and in its treasures of old days; the most notable of which was a well-oiled elephant's tusk beautifully browned and polished, which had lain upon the floor since the days of old Tanoa, who once prized it as the largest piece of "coin" in the world. Only the highest chiefs were permitted to enter his house, and even these dropped their titles and crouched silently against the wall awaiting his invitation ere they spoke.

In his every expression and gesture there was a stately consciousness of his high-born ancestry.

Although over sixty years of age, his finely muscular body still stood erect, with its dark bronze skin softened and smoothed through many a cocoanut-oil massage. Upon ceremonial occasions he blackened his

RATU EPELE, HEAD CHIEF OF FIJI IN HIS HOUSE AT MBAU IN 1899. Three yagona bowls, with their strainers, are hanging upon the wall. Ratu Pope Senlioli is at his right hand, and the others are chiefs of high rank.

face and covered his hair with lime. The little finger of his right hand had been severed at the first joint as an indication of mourning upon the death of his grandfather Tanoa.

He was every inch a king seated in his chair with the noblest of his race crouching silently around him. Whenever he smoked a cigar he condescendingly nodded to some high chief who crawled humbly toward him on hands and knees, delighted at the honor of "finishing the butt."

When he dined, a clean new mat was unrolled upon the floor, and then men and women came crawling in on hands and knees, bearing food for the god-like one, who sat tailor-fashion upon the floor. No commoner ate in the presence of the king, and least of all would the women of his household have presumed to such familiarity. The menu of one dinner at which the author was a guest consisted in an excellent fish chowder served in cocoanut bowls, and yams placed upon four-legged wooden platters, all scrupulously clean and cooked to tempt the palate of the most fastidious epicure. Our plates were banana leaves, and fingers served in lieu of knives and forks. Cups, etc., used by the king are tabu and must not be used by others. The courtiers remained silent while the meal was in progress, only softly clapping hands when the king addressed any of their number. After dinner a bowl of water was placed before the king and the natives again clapped respectfully while he washed his hands.

Even before the advent of the white man, cooking was a high art in Fiji. In fact, these natives had little to learn from us in this direction. Their pottery enabled them to boil or steam their food, and in addition they made use of the oven. This consists in a stone-lined pit within which a wood fire is made. Then, when the stones have become red hot the embers are raked away and the food; pigs, fish, vegetables, etc., are placed within the oven, having previously been wrapped in Tahitian chestnut or bread-fruit leaves, or in the case of man in the leaves of *Solanum anthropophagorum,* a plant allied to the potato. The food is then covered thickly with juicy green leaves which in turn are blanketed with earth. After a few hours all within the oven becomes so thoroughly baked that the ribs of pigs may be torn off and the flesh eaten as in America we do corn upon the cob.

Canoes laden with tribute (lala), for Ratu Epele were constantly arriving at Mbau. These offerings varied with the tribe, for each was charged to bring certain things. Thus one canoe might be laden with great bundles of yams, another with husked cocoanuts tied into bunches, or with yaqona root, turtles, masi, mats, etc. The greatest care was taken in the preparation of the tribute, and, in fact, the natives invariably gave the best they had.

Those who brought tribute carried it humbly to the door of the king's house and crouched close to the wall outside, softly and plead-

ingly clapping with their hands. Hearing the plaintive sound two chiefs of the king's household, who had hitherto been sitting motionless as statues within the room, moved to one and the other side of the door. The head of a pig, a large bunch of cocoanuts, or a turtle would then be timidly thrust part way within the opening, and a tremulous voice outside would beg that his majesty, their great and gracious lord, would condescend to accept as tribute so mean and unworthy an offering as their poverty forced them to present, trusting that in his greatness he would continue to protect and show them favor. When the voice ceased, the two chiefs at the door would critically inspect the proffered specimen of tribute, calling attention to its faults as well as to its qualities, and if its acceptance was recommended, all the chiefs who had been crouching sphinx-like against the wall within the house would show signs of life and majestically clapping their hands murmur "A! woi! woi! woi!! A tabua levu!" (a wonderfully large whale's tooth!). Upon which the king himself usually spoke a few words and the tribute was formally accepted. So abundant was this tribute that great heaps of taro, yams, cocoanuts or turtles were nearly always to be seen upon the village green of Mbau.

In the old days, wars were waged over the slightest inattention to this matter of tribute. The island of Maliki was charged to provide turtles for Tanoa, but one day they presumed themselves to eat one of the turtles they had caught; hearing of which Tanoa sent a fleet of war canoes, and every man and woman on Maliki was killed, the children being captured in order that the boys of Mbau might club them to death and thus earn their titles of Koroi (killers of men).

The old king spoke not a word of English, but he was fond of reminiscence. He remembered the *Peacock* of the Wilkes expedition, being then a boy of about 8 years. He also spoke admiringly of Professor Moseley, of the *Challenger,* and seemed saddened when told that he was dead.

The freedom with which he volunteered to discourse upon events of cannibal times was surprising. He said that one day when he was a little boy he had entered the house of Tanoa during the dinner hour, and his grandfather, who always loved him, had given him the tongue of the Mbakola[6] (man-to-be-eaten) and its taste was vinaka (good). After this he "often dined with his grandfather," who "had a new man nearly every day." Wilkes states that the Fijians esteemed women more highly than men, but Ratu Epele declared that the best of meat were old, lean men "whose flesh was red and whose fat was yellow," and whose taste was "like pork with bananas." Women, he declared,

[6] Long pig, "Vuaka-mbalavu," applied to designate cooked man, is not grammatical Fijian, but is derived from a joke of the inveterate old cannibal Tanoa.

were "covered with a layer of fat" and white men he had been told were salty or flavored strongly with tobacco. In old days in Fiji, the highest praise one could bestow upon a dish was to liken it to a cooked man. When in Fiji, I several times overheard the remark "were it not for the English I would eat you," and in quarrelling the commonest slur is to call an antagonist (Mbakola) a man to be eaten. Our abhorrence of cannibalism, which is after all a sentimental matter in so far as the mere eating is concerned, was not shared by the old Fijians of experience, for "men are good; indeed the best of all meat," and as Ratu Epele once said "he never met a man without thinking how he would taste."

Some Fijian names for food are curious; thus bula-na-kau signifies beef, for when Captain Eagleston brought the two original cattle to Fiji he told the natives that the animals were a "bull and a cow."

Ratu Epele delighted to play at draughts with a tawny-haired albino chief whose light skin was profusely bespeckled with brown blotches and whose eyes were dull blue. This chief's function seemed to be solely that of a messenger and draught player, and invariably the games were won by the king, for no matter how great an advantage the albino might win, he "committed suicide" at the last by placing all his pieces at the mercy of his lord and master.

Ratu Epele, the most interesting chief in the Pacific, died in 1901, and with him there passed away the last champion of the old in Fiji. Born of the highest rank and to a life of war and action, fate had robbed him of his birthright and left him but dreams and memories. Like the lingering spark of a fire that can never burn again, this spirit of old cannibal days faded into oblivion. His son, the Honorable Ratu Kadavu Levu, who succeeded him as Roko Tui Tailevu, has been carefully educated under British auspices, and is a member of the Legislative council.

The cleanliness of Fijian houses is remarkable, indeed in heathen times they were far more careful in this respect than at present, for the least offal of any description, even a hair, might be used by an enemy to bewitch its originator. Even to-day the fear of witchcraft, Ndrau-ni-kau, is very real in Fiji. In order to bring ill-fortune to your enemy, you have but to discover something which he has cast off and burn it wrapped in the proper leaves, reciting certain spells. Or you may bury a cocoanut beneath his hearth, or slowly melt the wax from his image thus causing your victims lingering decline and death. The missionaries have made every effort to destroy this belief, but unfortunately they do not seek to replace it by a more wholesome understanding of the nature of filth-diseases, and thus as faith in witchcraft declines certain bodily ills increase.

In common with other south-sea islanders, the Fijians were a cere-

monious people and every important affair of life was ordered in accordance with a rigid etiquette which unhappily in many instances is falling into neglect before the levelling influence of the white man's law.

Thus in the old days, the yaqona (kava of Samoa) was drunk by chiefs alone, and then only upon ceremonial occasions, but now all may partake of it and the excess thus engendered is one of the minor causes of the decline of the population. Wilkes, and also Williams, in his work on Fiji and the Fijians, describes the ceremony at Somo somo where it was most elaborate. Early in the morning the herald stood in front of the chief's house and shouted yaqona ei ava, and all within hearing responded in a shriek Mama (prepare it). Then the chiefs and priests gathered within the king's house, while all others remained at home until the king had drunk his yaqona. Pieces of the root of the *Macropiper methysticum* were distributed among the young men, who must previously have rinsed their mouths and whose teeth must be perfect. The chewed root having been deposited in the form of relatively dry pellets in the bottom of the bowl, the herald announces to the king "Sir with respect the yaqona is collected." The king replies "Loba" (wring it). The bowl is then placed before the chief, who skilfully encloses the chewed fragments of root within fibers of hibiscus or cocoanut husks and finally wrings the fluid through this sieve, thus removing from the bowl all pieces of chewed root, and leaving within it a milky-yellow brew. While the straining is progressing, the priest chants a prayer in which the company finally joins. The first cocoanut cup is always handed to the king, who pours out a few drops as a libation to the gods and then drinks while the assembled company sing, Ma-nai-di-na. La-ba-si-ye: a ta-mai ye: ai-na-ce-a-toka: Wo-ya! yi! yi! yi!, finishing with a clapping of hands and a wild shout which is passed from house to house to the uttermost limits of the village. After the king, the company is served in the order of rank until all have partaken. In old times, it is said that yaqona was grated in Fiji, but that the Tongans introduced the method of chewing. Having tried it, I must confess that the chewed root is less unpleasant in flavor than the grated, but at best it resembles a combination of quinine and camphor and is certainly an acquired taste. When drunk to excess, it temporarily paralyzes the arms and legs, at the same time exciting the brain. Thus violent quarrels are apt to occur at yaqona bouts, but the combatants are unable to injure each other. When the chief falls into a stupor the wives of the other participants carry their protesting husbands home. A dull headache upon awaking is the penalty for this over-indulgence, but the evil effects are slight in comparison with those resulting from alcoholic excesses.

The British government has, however, prevented alcoholism among the natives; for each Fijian who desires to imbibe must annually ob-

tain a license which he is obliged to exhibit whenever he purchases a drink at any public bar, and if arrested for drunkenness his license is confiscated, not to be renewed, and moreover the bartender is heavily fined if he be detected in selling drinks to natives who possess no license.

The Fijians of to-day are more orderly and sober than, and quite as contented as are any peoples of European ancestry, and illiteracy is rarer in Fiji than in Massachusetts. You were safer even fifteen years ago in any part of Fiji, although your host knew how you tasted, than you could be in the streets of any civilized city. It is clear that in *disposition* the Fijians are not unlike ourselves, and only in their time-honored *customs* were they barbarous. Indeed the lowest human beings are not in the far-off wilds of Africa, Australia or New Guinea, but among the degenerates of our own great cities. Nor are there any characteristics of the savage, be he ever so low, which are not retained in an appreciable degree by the most cultured among us.

Yet in one important respect the savage of to-day appears to differ from civilized man. Civilized races are progressive and their systems of thought and life are changing, but the savage prefers to remain fixed in the culture of a long past age, which, conserved by the inertia of custom and sanctified by religion, holds him helpless in its inexorable grasp. Imagination rules the world, and the world to the savage is dominated by a nightmare of tradition.

It is not that there are no individuals of progressive tendencies among primitive tribes, but the careers of their Luthers and Galileos are apt to be short and to end in tragedy. Indeed, only three hundred years ago our own leaders of progress struggled at the risk of their lives against the prejudices of their contemporaries. Even with us every effort of progress engenders a counteracting force in the community which tends to check its growth and to preserve the present status, accepting the acknowledged evil of to-day to preserve the even tenor of our way, for fear of the new is akin to the superstitious dread of the unknown. Whether the race be savage or civilized depends chiefly upon the nature of the customs that are handed down as patterns upon which to mold life and thought. The more ancient the triumph of the conservatives the more primitive the culture which is conserved, and the more likely is it to be crude and barbarous. A wonderful instance of fixity of custom is afforded by the race which in the ice-age lived in the caverns in the valleys of the Dordogne and the Vezere in central France. Their skull measurements indicate that certain of these cave-dwellers were Esquimo and their implements and works of art are the same as those of the Esquimo of the Arctic regions of to-day, who have thus remained unchanged throughout unknown thousands of years, unaffected by their great journey northward following the edge of the retreating ice.

Among all races religion is the most potent power to maintain tradition, and for the savage religion enters into every act and thought. To him as to the ancient Greeks everything is a personification of some spirit—everything is somebody. The waterfall is such, for can you not hear the laughter of the nymph, the clouds are spirits for they come and go as only gods may do, and every beast and bird and plant and stone is but the embodiment of a ghost or tribal hero.

Yet it is probable that no savage has ever been more under the dominion of a world of omens and portents than was Louis XI, and even to-day the breaking of a mirror, or the number thirteen, or a stumble while crossing a threshold, remains of significance to many of us. All matters of sentiment and credulity are closely wrapped up in this entanglement of superstition; it is hard to divorce ourselves from the idea that moving machines have life and disposition. We must perforce associate sublimity and grandeur with the inert rock-mass of the Alps, and the great trees under which we played as children are sentient beings to our imagination, and our hearts ache as for the loss of life-long friends when we find them fallen to the woodman's axe. A cold heartless world it indeed would be were we not illogical and therefore "savage" in our sentiments and loves.

Upon analysis we find that lack of sympathy for the savage and ignorance of his tradition blinds our judgment and causes us to regard as ridiculous in him things which we consider to be quite natural in ourselves. The cleverness of the Yankee who sold wooden nutmegs is quite amusing, but the Japanese who counterfeits an American trademark is criminal.

There is within us Europeans an inbred contempt for all that is alien, and this trait, being the dominant characteristic of Christian peoples, has enabled us through aggressive intolerance to impress our customs upon all other races without ourselves being influenced by the cultures we have overawed into a semblance of our own.

In strange and possibly ominous contrast with ourselves, the Japanese have for ages been keen to discover the good things of alien cultures and quick to accept them as their own, while we must remain all but unmoved by the example of their ennobling patriotism and mastery of self, the happy simplicity of their family life, their respect for worthy ancestors, their modesty, and their inbred grace of deportment; and as for their exquisite art we chiefly relegate it to our museums, and their fine chivalric code, the bushido, remains all but untranslated into our language, much less has it entered into our thought.

The savage may know nothing of our classics, and little of that which we call science, yet go with him into the deep woods and his knowledge of the uses of every plant and tree and rock around him and his acquaintance with the habits of the animals are a subject for constant won-

der to his civilized companion. In other words, his knowledge differs from ours in kind rather than in breadth or depth. His children are carefully and laboriously trained in the arts of war and the chase, and above all in the complex ceremonial of the manners of the tribe, and few among us can excel in memory the priests of old Samoa, who could sing of the ancestors of Malietoa, missing never a name among the hundreds back to the far-off God Savea whence this kingly race came down.

One may display as much intelligence in tracking a kangaroo through the Australian bush as in solving a problem in algebra, and among ourselves it is often a matter of surprise to discover that men laboring in our factories are often as gifted as are the leaders of abstract thought within our universities. In fact the more we *know* of any class or race of men the deeper our sympathy, the less our antagonism, and the higher our respect for their endeavors. When we say we "can not understand" the Japanese we signify that we have not taken the trouble to study their tradition.

It is a common belief that the savage is more cruel than we, and indeed we commonly think of him as enraged and of ourselves in passive mood. Child-like he surely is, and his cruelties when incensed are as inexcusable as the destruction of Louvain or the firing of Sepoys from the guns, but are they more shocking than the lynching or burning of negroes at the stake, events so common in America that even the sensational newspapers regard them as subjects of minor interest.

Clearly, despite our mighty institutions of freedom, efficient systems of public education and the devotion of thousands of our leaders to ideals of highest culture, there remain savages among us. Mere centuries of civilization combat the æons of the brute. Within each and every one of us, suppressed perhaps but always seeking to stalk forth, there lurk the dark lusts of the animal, the haunting spirit of our gorilla ancestry. The foundations of our whole temple of culture are sunken deep in the mire of barbarism. It is this fundamental fact which deceives us into the impression that a few decades of contact with men of our own race will suffice to civilize the savage. True they soon learn to simulate the manners and customs of their masters, but the imitation is a hollow counterfeit, no more indicative of enlightenment than is the good behavior of caged convicts a guaranty of high mindedness. To achieve civilization a race must conquer *itself,* each individual must master the savage within him. Cultured man has never yet civilized a primitive race. Under our domination the savage dies, or becomes a parasite or peon.

TRADE UNIONISM VERSUS WELFARE WORK FOR WOMEN

By ANNIE MARION MACLEAN, PH.D

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PERHAPS the most popular phase of philanthropic endeavor at the present time is that which deals with the improvement of industrial conditions for women. That their lot is unduly hard is evidenced by the facts of the case. Women have always worked and are therefore no innovation in industrial life; yet the spectacle of their toiling in ever-increasing thousands in this country has stirred alike alarmists and reformers, and they have given publicity to hardships always endured by the workers, but hitherto undreamed of by the more favored members of society. Eight millions of women are now engaged in gainful occupations and the great majority of them are under twenty-four years of age.

The youthfulness of so large a number of women makes its own appeal for sympathy, even though it is not powerful to bring about more equitable arrangements in industry. Society, it would seem, is usually lavish with sympathy, but niggardly with justice. But of late we have become obsessed with the idea of meting out justice to the unborn. The inevitable outcome of this, of course, must be fair treatment to the potential mothers. In so far as it results in sane activity in their behalf well and good. Four millions of the eight classed as women in gainful occupations are industrial wage earners, a group sufficiently large to leave its impress on the health and morals of the future.

It can not be denied that modern methods of industry tend to push oppressively hard upon unskilled young women, who have neither ability nor training to enable them to engage in interesting tasks. They are often forced into the most monotonous kinds of labor, where they are poorly paid and obliged to work at nerve-destroying speed. A dawning interest in public health has focused attention upon the physical effects of such toil, and it has also, coupled with certain moral conditions, led to the important investigations into industrial conditions for women that have been carried on during the past few years. People who, a decade or two ago, neither knew nor cared how or where their clothes or food were made, or by whom, now exhibit a lively interest in these matters. It is an awakening of social conscience that omens well for the worker. But even an awakened community works slowly in the matter of reforms. It takes a long time to enact and enforce desirable legislation. In the interim something must be done. Much in fact has

been done by organizations large and small, but out of all this endeavor two types of undertakings stand out conspicuously as coming close to the heart of labor and trying to correct abuses. They are trade unionism and employer's welfare work. A consideration of these two agencies, in so far as they affect wage-earning women, forms the subject-matter of this discussion. The two agencies represent distinct, even antagonistic methods, and in fact are usually mutually exclusive.

For about half a century, the trade organizations have been striving, by fair means and foul, to get a voice in the conduct of the businesses in which they work, for the purpose of improving their own condition. The end for which they have striven is laudable. They have been calling for sanitary workshops and living wages; for shorter hours and more certainty of employment; and all the time emphasizing their right to be heard. This movement is especially deserving of notice because it is a movement by the wage workers, for the wage workers—those who are admitted to need help striving to help themselves. This, in theory at least, is the most hopeful of all undertakings, and it is the spirit that should be fostered. The working people have set up for themselves a definite standard of living, which they desire to reach, when they organize together in their trades.

Whatever may be said about methods sometimes employed by the trade organizations, it must be admitted that their theory of industrial betterment is rational. They stand for the uplift of labor, and theirs is a herculean task. They are attempting to push themselves up against forces apparently conspiring to keep them down. This opposition has lent a strength and militant vigor to their purpose. They hold up to themselves the definite ideal of self-improvement, and the tenacity with which they cling to this ideal shows the faith they have in it. A more comfortable working class is their hope. They pursue their purpose oftentimes with set teeth and clenched fists, and their zeal is an inspiration in itself. They have a goal, and with steadfast purpose they are striving to reach it.

Industrial betterment of this kind tends to produce a virile body of citizens, and the test of any ameliorative work must, in the last analysis, be the effectiveness of the citizens it develops. This method of improving conditions is only beginning to seize the imagination of women; its possibilities are only beginning to be realized, and by representative bodies of women fully as much as by wage earners themselves. The great majority have been slow to avail themselves of the benefits arising from organization. Many of the workers feel that their stay in the industrial world is temporary, and they are either indifferent to the conditions under which they must work for a time, or they are unwilling to subject themselves to what they frequently regard as the tyranny of leaders, preferring rather to endure low wages and bad

sanitation if need be till marriage sets them free. This and other reasons which have kept women wage earners from adopting union ideals in the past are still operative it is true, but the more intelligent are beginning to see the benefits of organization, and are uniting with others of their trade for mutual betterment. Union men have not always been friendly toward unions for women, chiefly for the reason that they feared the acceptance of women into their ranks might militate against increased wage scales. Their attitude has changed, however, and this has had its share in stimulating an interest in organization among even young women workers.

Many persons interested in social betterment are now growing sanguine over the possible future of women's unions, owing to certain successes achieved by them in the garment and other trades in recent years. Hitherto the union has flourished most in time of stress. There is inspiration in a fight, and, moreover, a fight is sometimes necessary to overcome injustice. But these working women need, too, the ministry of peace, and when the unions shall have passed through their militant stage, the women workers will doubtless be the gainers. Union women are now standing shoulder to shoulder in their effort to obtain higher wages, shorter hours and healthful conditions of work. If they have these, they say they can provide themselves with opportunities for education, and recreation, and other desirable things in life. They are fighting for a chance to work, and a chance to live.

The other form of industrial betterment under discussion is that carried on by more or less philanthropic employers, and through the National Civic Federation called "welfare work." Such work is as varied as the employer's appreciation of needs, or ingenuity in suggesting remedies for existing difficulties. With one it may take the form of shower baths, and a system of profit-sharing; with another hot noonday lunches and dancing classes; while still another may discharge what he considers his duty by providing club rooms for men, and aprons for women. But whatever the method pursued, vastly better physical conditions have resulted. Welfare work has given us model factories, and beautiful surroundings must ever be an incentive to right living.

Several hundred employers in the United States are carrying on some form of betterment work for their employees, while ten or a dozen stand out prominently for their unusual, even notable, undertakings. In general, welfare work may be said to include: (1) improved physical conditions; (2) opportunity for rest and recreation; (3) educational work; (4) benefit funds.

Now each of these things is good in itself, and employees, while as a rule willing to recognize the truth of this, yet are more or less suspicious of their employers' undertakings. They do not object to the

good things, but to the methods of bestowing these good things. Many thoughtful employers, having been beset by labor difficulties, have concluded to make conditions of work pleasanter, in the hope of banishing dissatisfaction. The plan has been successful in some cases. Sometimes these employers are poor psychologists, inasmuch as they fail to understand why blissful content does not follow on the heels of some gift. The young women asked, perhaps, for higher wages, and were given rest rooms and free lunches. Why, forsooth, should they not be happy? Chiefly for the reason that a sop never satisfied anybody. However, many who have grown to distrust union methods are looking with hopeful eyes to employers' betterment schemes as the final solution of labor difficulties. Capital and labor working together for mutual benefit is undoubtedly the ideal condition. But they must really work *together* if the most desirable results are to be obtained.

Having before us the main features of trade unionism and welfare work, let us now discuss these two agencies. As was stated before, the final test of the value of an institution is the type of citizen it produces. When we seek to improve an individual, we have in view not only the present comfort of that individual, but his future usefulness to society. We feed a hungry boy, not only to keep him quiet and make him fat, but to make him a man. So in all ameliorative work we must keep ever before us the final purpose of it all. The work in itself is of value only in so far as it helps to make better men and women of those whom we would help.

Our duty is toward society at large, and we can discharge it only by helping to promote good citizenship. Now in order to be the best type of individual one must have ever before him an ideal, and an instiution which would elevate any class in society must present to that class a definite ideal; it must give it something for which it must strive, for I am bound to believe that no individual or group will advance very far without this inspiration. "Without a vision all the people perish." Now if we accept this doctrine of social righteousness based on ideals, let us see how far these two industrial betterment agencies under consideration are in harmony with it.

The trade unions in all their bickerings, and turmoil, and failures, and successes, have never lost sight of their goal of better working and living conditions. The union holds up to its members the ideal of class betterment. They are stimulated to further endeavor by this. We must therefore concede to the trade unions a place in our scheme of industrial regeneration. The principle for which the union stands is sound.

Let us now enquire into the social value of employer's undertakings. Here we come to an entirely different situation. The employer is the active force, the employee the passive agent at the outset, and if this condition changes it is owing to the tact of the employer. Welfare work,

then, comes to be a bestowing by him who has upon those who have not.

The wealthy employer is touched perhaps by the weary face of one of his women workers, and he immediately opens a rest room; he sees her drinking cold coffee from a can, and he makes plans for serving a hot lunch; he sees her look longingly at a few flowers beyond her reach, and he transforms his factory into a veritable garden; he sees her standing at her work with weary limbs, and he straightway orders high-backed stools. Any employer who allowed his heart to accompany him on a trip through his factory or store would see a score of things he could do for the comfort and happiness of his employees, and if he went forth and did them would be himself a better citizen thereafter. But what of the people whom he has helped? What ideal has he given them? They are recipients of favors. They may have better health on account of his gifts; they may even be happier. But there is something in the average American working man or woman that resents even health and happiness if mixed with patronage; and unless an employer has phenomenal tact his efforts are likely to be regarded as paternalistic. Working women as a rule accept favors more readily than men, with the result that they are more prone to betray some of the characteristics of spoiled children. On the employer's side there is always the temptation to turn to business profit the improved conditions his generosity has made possible. His welfare work may thus become simply advertising, and his employees may be exploited to their humiliation. The employer undoubtedly is entitled to whatever commendation a humanitarian policy may merit, but when that policy is adopted solely for the financial benefits that may accrue from popular approval, it becomes questionable, possibly meretricious, from the ethical standpoint, and certainly should not be accorded a place in the field of ameliorative undertakings. Such work belongs simply to the realm of advertising, and has nothing whatever to do with the broad ethical movement we are considering. Its contribution to the solution of industrial difficulties is a negligible quantity.

The employer who installs shower baths, and then with a blare of trumpets—possibly accompanied by moving pictures of employees performing their free ablutions—calls his goodness to the attention of the passer-by, belongs to the same class as a circus manager who exploits the tricks of his animals, not because he poses as the savior of the animal creation, but because he hopes it will induce money to flow into his coffers. We must, then, make a clear line of demarcation between the schemes of an enterprising publicity agent and genuine purposeful betterment work. The value of welfare work must ever depend on the employer who undertakes it. So far as employees are concerned, they are actuated by no strong purpose. They have greater comforts without the spiritual stimulus of working to get them. Such undertakings do not present a definite ideal to strengthen and enrich character, to

develop the best type of citizenship. The chief weaknesses, then, of this system seem to me to be an inherent tendency toward paternalism, with its consequent emasculating or embittering of labor; its lack of the cooperative spirit; and its failure to hold up an ideal.

There are many things in life of more importance than window boxes filled with trailing vines and bright blossoms; there are more pressing needs for girls than fresh white aprons. And the would-be philanthropic employer who does not recognize this is doing less than his whole duty. While providing for the physical comfort of their employees, employers should recognize the fact that they assume certain moral as well as economic responsibilities when they bring together large numbers of workers. And it is this ethical side of welfare work that is most significant; it is the side that has the most direct bearing on good citizenship. It is quite possible for a working woman to discharge her full duty to society without having luxurious couches on which to lie when she grows ill or weary from toil, but it is not possible for that woman to fulfill her duty as a member of the social group unless she is capable of exercising the power of choice, of standing firm as a moral entity, of grasping and holding to a definite ideal of progress.

Now my contention is that the present tendency of welfare work is not to strengthen labor's power of initiative, and is not to summon to the fore that virile zeal which belongs to sturdy manhood and womanhood. When the employer has been the means of rousing his employees to action, of encouraging them to evolve methods of betterment, and of stimulating them to an appreciation of their opportunity to do things for themselves, the situation is much more hopeful. Some few employers in this country have been able to do this, but the general trend of the work is in another direction. And employees, surfeited with comfort for which they can give no return, are liable to become limp of will and uncertain of purpose. Their power of initiative becomes dwarfed. They are always open to the charge of ingratitude. The pampered children of industrial Utopias may become unfit for the competitive system of industry. There are remedies of course that could be suggested for all these difficulties, but it is not my purpose here to show how to revolutionize welfare work, but rather to point out its present tendency.

Now having before us the essence of the two betterment movements for women known as trade unionism and welfare work, and some comments thereon, it becomes pertinent to enquire which one merits the greater degree of approval and support from people interested in industrial and social amelioration, so far as young wage-earning women are concerned. The question really resolves itself into a very simple one, but nevertheless one that we may not be able to answer satisfactorily for a generation or more, that is, which method tends to give us the more efficient women, women who can function most capably in a democracy?

EURASIAN WATERWAYS IN TURKEY

By LEON DOMINIAN
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THE circumstance of contiguity by which the southeastern end of the Balkan peninsula almost abuts against the extreme northwestern shore of Asia Minor provides an Eurasian ford which has facilitated human intercourse between Europe and Asia. The Dardanelles, the Sea of Marmora and the Bosporus constitute in reality a single strait. From Tertiary times to our day a normal and interdependent sequence of events has occurred on its site. In the prehuman period it is possible to trace land-fracturing followed by gorge-carving, valley submergence and strait formation. The post-human development witnesses conversion of the locality into an important section of one of the most widely traveled highways of mankind. Two main routes intersect each other in the dividing waters. Their courses leading from northwest to southeast and from northeast to southwest are at right angles to each other. In considering the value of the region as part of a much trodden route, it is necessary to ascribe proper importance to its lines of communication with Europe and Asia.

A Balkan zone of depression extending west and south of the Balkan uplift affords natural access between the valley of the Danube proceeding from the heart of Europe and the Dardanelles-Bosporus passage. It is constituted by the wide valley of the Morava and the narrower Nichava course leading to the Sofia basin, whence penetration into the Thracian plains is obtained by the Maritza valley.

The corresponding function for the Asiatic shore is performed by the valley of the Sakaria and to a lesser degree by the Pursak river depression—both trending westward from the high plateau of western Asia.

The main roads from the Bosporus or the Dardanelles to the Sakaria river valley skirt the shores of the straits and the Marmora as they follow a coastal lowland fringing the Dardanian and Bithynian heights. At Panderma, however, the old highway strikes inland slightly south of east to Brusa in order to avoid the elevated plateau intervening between the Marmora and Lake Abullonia. Thence, still following a line of least elevation, it wends its way towards the small harbor of Ghemlik (the Cius of Græco-Roman times) until beyond Isnik (ancient Nicæa of ecclesiastical fame) it debouches into the waters of the Sakaria.

The geological evidence at the shores of the Dardanelles and the Bosporus reveals the probable continuity of land at both points in a

time not far remote. A narrow band of the Miocene beds of the Gallipoli peninsula extends along the eastern coast of the Dardanelles. The lower Devonian strata and igneous flows of the European side of the Bosporus reappear on its Asiatic shores. In both straits the land-splitting fracture which gave rise to watery channels is an event of late geological times. Originally gorges of rivers flowing from northeast to southwest, the straits assumed their present geographical form as a result of depression. As one stands on the Sheitler hill midway between the Black Sea and Marmora entrances of the Bosporus the correspondence of promontory to bay and bay to promontory is discernible in the entire range of vision swept by the eye to right or left. A similar relation between opposite shores recurs in the Dardanelles with the only difference of size of landforms for, in the longer strait, the headlands are bolder while the bays attain deeper and wider proportions.

The importance of the region as a fording place can be gathered from the distribution of the larger cities within its boundaries. Setus, Abydos and Madytus on the Hellespont grew on the site of the nearest convergence of the European and Asiatic land-masses. The same is true of Byzantium, with the added circumstance that the promontory on which it was founded afforded an admirable strategic site. Ilium, at the southwestern entrance of the waterways, also owed its importance during antiquity to commanding position. Its disappearance as a center of urban life was the result of geographical disadvantages. The ancient city lacked a convenient harbor, above all. Land communication with Asia Minor was arduous on account of the mountainous character of the country extending beyond the city walls. Byzantium, however, at the opposite extremity of the straits had been provided by nature with the very facilities for intercourse which had been denied Troy. The economic conditions which were responsible for the passing of the latter city determined the survival and increasing importance of the Byzantine capital.

The narrowness of the Eurasian waterways permitted continuity of travel over this intercontinental route while the very existence of the straits allowed uninterrupted maritime travel from Black Sea harbors to the farthest known seaports of the western world. Modern railway communications have been benefited by the former circumstance. The sea commerce of medieval days thrived on the latter. In fact, the configuration and location of the region has always affected humanity.

Assumption of the wandering of Alpine brachycephals from the Hindu Kush to as far west as Brittany appears to be substantiated by the distribution of the type. The connecting link between members of the race in western Europe and their Asiatic prototypes is found in the Armenoid group of Asia Minor.[1] Probably the earliest fording of

[1] Ripley, "The Races of Europe," New York, Appletons, 1899, p. 448.

Eurasian waterways was undertaken by this race in the course of its westerly spread.[2]

This specific case of migration may be considered as part of the powerful "trans-humanizing" process moving in an east-west direction which has taken place on the Eurasian continent. Interdependence between this movement and the conformable trend of the main lines of Eurasian structure as well as correlated climatic zones still remains to be determined. Ultimately the entire problem may be found to be connected to mechanical effects of our planet's rotation.

Since the dawn of historical times the Propontine area and its outlets have borne the vessels of adventurous traders and colonists. Early extension of Hellenic influence to the easternmost shore of the Black Sea was rendered possible by the advantages offered by this water route to Greek pioneers. The foundation of Byzantium in 657 B.C. promoted the intercourse between the east and west which at that time was largely restricted to relations between the Ægean and Black Seas. A half-way station was established on the unique site of the modern capital of the Sultans. Here a system of powerful defenses reinforced by the encircling waters of the Golder Horn, Bosporus and Marmora provided long lease of existence to the city which both Europeans and Asiatics regarded as the gateway to rival continents.

Between the Ægean mouth of the Hellespont and the Euxine outlet of the Bosporus, Asiatic invaders of the western world and European colonizers of the east have always found the shortest watery stretch of their respective routes. This was an important point at a time when control of natural forces was in a still undeveloped stage. The danger of impairing the cohesive strength of an army of invaders was also minimized.

These considerations probably led Darius to adopt the Bosporus route in the expedition sent against the Scythians in 513 B.C. His cohorts tramped from Asia into Europe over a bridge of boats thrown across the Bosporus in that year.[3] From that time on various incursions of Asiatics into the western continent were to cross the water of these straits.

During the second Persian war the bridging of the Hellespont by Xerxes' generals is commonly reported as having been undertaken between Abydos and Madytus. Both of these sites lie north of the narrowest section of the Dardanelles,—the Kilidbahr-Chanak gap, barely a mile in width. They correspond approximately to Nagara Point and the paltry hamlet of Maitos, between which the distance of the straits attains three miles. The current at the wider section is not as swift.

[2] *Cf.* map of Asiatic Migrations in The Wanderings of Peoples, by A. C. Haddon, Cambridge, 1912.

[3] Herod., B. IV., 86–89.

There the double row of pontoons built by Xerxes's engineers in 480 B.C. could be moored with less danger of their drifting with the southerly flowing waters. It is not improbable that the bridge thrown across the Hellespont on this occasion was started near the conveniently situated mouth of the Rhodius River and extended to a point about two and a half miles south of Madytus.

Half a century later the Hellespont was crossed by a counter human current which was destined to flow to the shores of the Indian Ocean. Macedonian supremacy over Greek states at that time depended largely on the conquest of Asia where ready help against the kingdom bequeathed by Philip to Alexander was always to be found by the states of Thessaly and the Peloponnesus. The bulk of the Macedonian phalanxes were transported from Europe to Asia between Sestus and Abydos in 334 B.C. It is likely that minor contingents crossed between Elacontus and the Achean's cove with Alexander who was proceeding to Ilium.

The main fording points selected on this occasion lie north of the previous passage. The distance between Sestus and Abydos is also approximately one mile. The advantage of the site, however, is due to the moderation of the current which flows between these points with about half the swiftness characterizing its onward rush through the contracted outlet on the south.

When the convergence of all roads to Rome had become well established in the first century after Christ, the Bosporus was the shortest watery section of a long highway which began at the Appian way and extending through Ancyra, Tarsus and Antioch, attained Egypt and Mesopotamia by way of branches diverging at the last-named city.

The easterly spread of the Roman Empire, however, caused the Bosporus to replace the Roman Tiber as the hub of spoke-like roads leading to the remotest confines of the Cæsars' vast administrative domain. The evidence afforded by the Peutinger Table and the Antonine Itinerary on this translation of center is conclusive. In the words of Ramsay[4] the map

> was made in the Byzantine period by a person who was accustomed to the Byzantine system of roads radiating from Constantinople across Asia Minor, and who tried to represent the roads on this idea. . . . But no road which leads across country from the Ægean coast is represented with any approach to completeness: the roads in this direction are given in fragments with frequent gaps.
>
> The same remark applies to the Antonine Itinerary: the compiler is interested chiefly in the roads to Constantinople. . . .'

In the early centuries of the Christian era the advantageous location of the waterways favored the development of trade intercourse between Europe and Asia. From the European coast roads led to the great

[4] "The Historical Geography of Asia Minor," p. 48.

commercial cities of lower Austria which at that time, and especially from the sixth to the twelfth century, were the depots and distributing centers of Oriental merchandise. Thither traders from the northernmost and westernmost sections of Europe came to supply themselves with the spices and rareties of the Orient. The Avars, who had settled in the valley of the Danube and who traveled back and forth in the wide valley of their choice, were the principal commissioners between Constantinople and the storing centers of Lower Austria.

At the apogee of Byzantine might the region occupied an eminently central location in the civilized world. In the sixth and seventh centuries from north to south and between east and west the Byzantine Empire was in every sense the country of the core. A large proportion of world commerce carried on between cardinal points of the compass passed through Eurasian waterways. This trade route grew in importance during succeeding centuries. It flourished especially throughout the period in which Italian cities acquired commercial supremacy.

Between the eighth and ninth centuries the commerce of Europe centered at Constantinople "more completely than it has ever since done in any one city." A commercial aristocracy was created in Byzantium as a result of this remarkable trade activity. The body of wealthy merchants rapidly acquired political power, and it became necessary for usurpers to obtain their support. Finlay, basing himself on Theophanes, records the case of Empress Irene, who was obliged to lower the toll levied at the straits of the Hellespont and the Bosporus in order to find favor with the business men of the capital at the time she was preventing her son from reigning.

In the course of the eight crusades between 1096 and 1270 the straits of the Bosporus provided easy passage from Europe into Asia to the soldiers of the cross marching against the infidel. Throughout the two centuries of faith-inspired fighting the nations of the world met in Constantinople. From the very start of the religious movement the bands of crusaders followed the roads provided by nature to this city, there to unite forces before proceeding through Asia Minor to Palestine. The four leaders of the first crusade set the precedent by convening in the Byzantine city. From Ratisbon along the valleys of the Danube, the Morava and Maritza, Godfrey of Bouillon led his host to the shores of the Bosporous. Adhemar of Puy and Raymond of Toulouse, proceeding from Burgundy through northern Italy, western Croatia and Bosnia, also attained the classic strait after crossing Albania, Macedonia and southern Thrace. The army of Bohemond and Tancred left Brindisi and landed in the bay of Valona, whence it was directed across the Balkan peninsula to the Byzantine capital. Robert of Flanders and Hugh of Vernandois marched through central Italy and, taking ship at Bari, crossed to Durazzo, there to begin the overland journey, the first

stage of which ended at Constantinople. Beyond the imperial city, in Asia Minor, the four routes which had marked the progress of the first crusade in Europe merged into a single trail over which the motley crowd of friar, beggar and adventurer, gathered from every European nation, steered its way towards Jerusalem.

From A.D. 1250 to 1425 Black Sea coast towns constituted western termini of important caravan routes proceeding from the heart of Asia. Tabriz, the great rendezvous of traders traveling from China, India or Arabia, was connected to Trebizond by the valley of the Arax. The seaports of Samsun, Poti and Tana also received the products of Asia destined for western Europe. The bulk of this Black Sea commerce was in the hands of Venetians and Genoese. Natives of the independent cities of Italy had their agencies in every Euxine harbor of any consequence. The Eurasian waterways had permitted the establishment of Italian commercial colonies on the coast of the Black Sea. Families claiming descent from Italian medieval settlers are found to-day in many harbors of ancient or modern importance.

If abundance of nomenclature on ancient maps be considered as expression of the commercial importance of a given region the names on the Black Sea coast preserved on medieval maps suffice to reveal the extent of trade relations between Italy and the Levant. The tonnage of Italian traffic with the East was derived not only from the important agencies like that of Galata founded by the Genoese within the present limits of Constantinople, but from numerous smaller posts and colonies scattered on the Black Sea coast.

The westerly spread of the Turks resulted in the gradual closing of the eastern waterways to Christian traders. In particular the control of the Dardanelles-Bosporus sea road by the Turks in the sixteenth century destroyed the most convenient avenue of intercourse between the prosperous Italian republics and their Black Sea colonies. From this time on trade relations between north-central Mediterranean ports and the Ægean and Black seas dwindled to insignificance on account of the restriction imposed by the Turkish government and the vexations to travelers caused by its officials.

The destruction of this Levant trade, however, did not end the demand of Europe for the products which the East had hitherto supplied. Spices consisting principally of pepper, cinnamon, ginger, cloves and nutmeg were still sought. The stocks of silk, gum, lacquer and certain perfumes and precious stones were being gradually depleted. These products now reached Europe intermittently and by way of southerly routes through Asia Minor, Syria and Arabia. The journeys to which traders had to submit were long and perilous. The result was that spices sold in Italian ports three or four times higher than in Calicut. Incense could only be obtained at six times its selling price in Mecca.

Furthermore, the scarcity of gold and silver was beginning to be felt acutely about that time in Europe. After paying its eastern purchases with the precious metals for centuries the west had reached the stage in which its supply of coins was failing.

These are some of the economic conditions which led to westerly explorations in the course of which America was discovered.

The consolidation of Ottoman dominion in Europe after the fall of Constantinople marked the highest development of the strategic value of the waterways. This feature was considerably enhanced by the introduction of artillery as an arm about that time. Prior to the establishment of the Turkish capital at Constantinople the strategic position of the straits had proved valuable in two important directions. For long it had acted as a natural moat defending European sections of the Byzantine Empire from Turkish attacks. In still earlier times and with the stronghold of Constantinople at its northern end the Eurasian ford had acted as the barrier deflecting barbarian invasions through Illyricum to Italy and the west. With armies and navies resting on the triple circle of Byzantine ramparts the narrow waterway was converted into a natural obstacle in the path of barbarian hordes which had succeeded in crossing the Danube in the course of recession from the northeast. Asia Minor, Syria and Egypt were thus spared the effects of the passage of invaders coming from the north.

The existence of the straits has profoundly affected the destinies of the Ottoman Empire. Turkey's disintegration marked by successive southeasterly recession of its European boundary was retarded considerably by the impregnable character of the defensive works constructed on the winding shores of the Dardanelles. This narrow strait attains a length of forty miles between the Ægean and the Marmora. A contracted channel, marked sinuosity of course and a line of hills on each shore commanding the intervening watery space provided all the elements which nature could bring together to form a fortress.

In modern times the waterway has played an important part in the rivalry between western and eastern nations for its possession. In particular, whenever the pressure of Slavic might tended towards a final effort to subjugate the Turk a convenient check could be promptly administered by an armed force sent through the straits to protect the Sultan's capital.

The international status of the waterway has been affected by its intercontinental location. As a section of an important world route its fate concerned every nation whose subjects made use of this highway. The long-deferred expulsion of Mongolians and Tatars from European soil can only be explained by the fact that the Turks descended from these races were the convenient masters of this important waterway. The occupation of this region by a power of the first mag-

nitude could not be tolerated by the other large nations in view of the menace constituted thereby to unimpeded transit of men and merchandise.

Expression of the tense political situation resulting from the importance of the site is given in the number of treaties forbidding the transit of armed vessels through the straits. Conventions signed by Turkey and European powers prior to the nineteenth century had closed the straits of the Dardanelles as well as the Bosporus to men-of-war. In the middle of the nineteenth century these agreements acquired validity as declarations of a principle deserving permanent application. An international conference, held in London, ratified on July 13, 1841, all previous agreements by the signing of a convention in which the Sultan bound himself to forbid access of the Dardanelles or Bosporus to foreign war vessels. The European signatory powers to this agreement were Great Britain, Russia, France, Austria and Prussia.[5] Since then the value of mastery of this watery stretch of an intercontinental route has acquired such proportion that the presence of storm-tossed war-vessels seeking refuge from the fury of the elements sufficed to raise vehement protests against their presence in the forbidden waters.[6]

To our own generation at a time when the economic importance of a region is the prime consideration affecting its world relation the gauging of the value of the Eurasian waterways must be determined by their central location with reference to the continents of Europe, Asia and Africa. Between Paris and Bagdad or Aden the overland route is continuous save for a short mile of water at the Bosporus. Here a bridge will undoubtedly connect the two continents in a day which can not be delayed much further. Man's achievement will thus have crowned nature's work once again. A minimum width of channel breaking the continuity of land along the northwest-southeast intercontinental road provided by nature is a requirement of modern conditions no less than it was in former centuries. Present exigencies differ, however, from the necessities of early days. Security had formerly been sought in the well-nigh unbroken stretch of land affording access from Europe to Asia, and vice versa. Rapidity of communication has now become the desideratum of greatest import.

Thus the advantages inherent in the site of the Dardanelles to Bosporus Strait determined its relation to humanity settled far from its limited area. A road is to a large degree the joint property of its users. The political status of the Eurasian waterways hence affects the inter-

[5] P. Macey, "Statut International des Détroits," Lechevalier, Paris, 1912.

[6] In October, 1849, a British fleet under the command of Admiral Parker while at anchor in Besika Bay was driven by a violent storm to seek shelter at Hauslar Bay in the Dardanelles. The incident elicited a protest from the Russian ambassador in Constantinople, notwithstanding the retirement of the English men-of-war to Besika Bay after the storm had subsided.

ests of the entire community of European nations. In this a determining factor is obtained which may lead to the eventual formation of an independent political unit formed by the elongated zone of coastland enclosing the Dardanelles, the Sea of Marmora and the Bosporus. The boundary of this territory in the Balkans, if made to coincide with the line determined for Turkey's western boundary at the Treaty of London of May 30, 1913, would conform fairly accurately with natural divisions. On the Asiatic side the valley of the Sakaria and a long fault line revealed by the lakes east of the Marmora provides ready-made frontiers which could be conveniently extended to the Ægean. This line had constituted the Asiatic boundary of the Latin Empire of Constantinople in the period intervening between the years 1204 and 1261. To-day the establishment of an internationalized area or neutral zone in this region would be an added instance of conformity to geographical principles observable in many sections of the world.

SOME PIONEERS IN MOSQUITO SANITATION AND OTHER MOSQUITO WORK

By Dr. L. O. HOWARD
BUREAU OF ENTOMOLOGY

IN planning, as early as 1903, a monograph of the mosquitoes of North and Central America and the West Indies which should be of service to zoologists and sanitarians,[1] the writer included in his outline plan some consideration of the pioneer workers in this field, and with considerable trouble secured the photographs which are reproduced in this article. He well knew the interest which always attaches to the personalities of men who do great work, and felt sure that the publication of these likenesses would add greatly to the interest of the monograph. But when the monograph was completed and printing begun, he discovered that the Carnegie Institution of Washington had laid down a rule that the portraits of living men were not to be published in any of the volumes issued by the institution. This was rather embarrassing, since it had been definitely stated to the foreign workers that the photographs would be used in this way; but since this was impossible, it seems desirable to have them appear in accessible form, and it is with full confidence that the readers of The Popular Science Monthly will be glad to know what these men look like that these lines are written. During the four or five years following Ross's discovery of the carriage of malaria by certain species of *Anopheles* there was intense activity in many parts of the world in mosquito investigations, and it is the pioneer workers of this period who are here shown. The only very prominent worker who is omitted is Robert Koch, whose photograph I was unable to secure. The only Americans included are the original members of the Army Yellow Fever Commission, Dr. A. F. A. King, of Washington, Dr. J. H. White, of the U. S. Public Health Service, and Surgeon-General Gorgas, who during that period had accomplished his wonderful clean-up of Havana.

They are a fine, forceful set of men, as their faces show, and to this group the world for all time will owe much. Nearly all of them are, or were, known personally to the writer, and he can thus assure those who read this article that the faces of the men themselves are like their photographs.

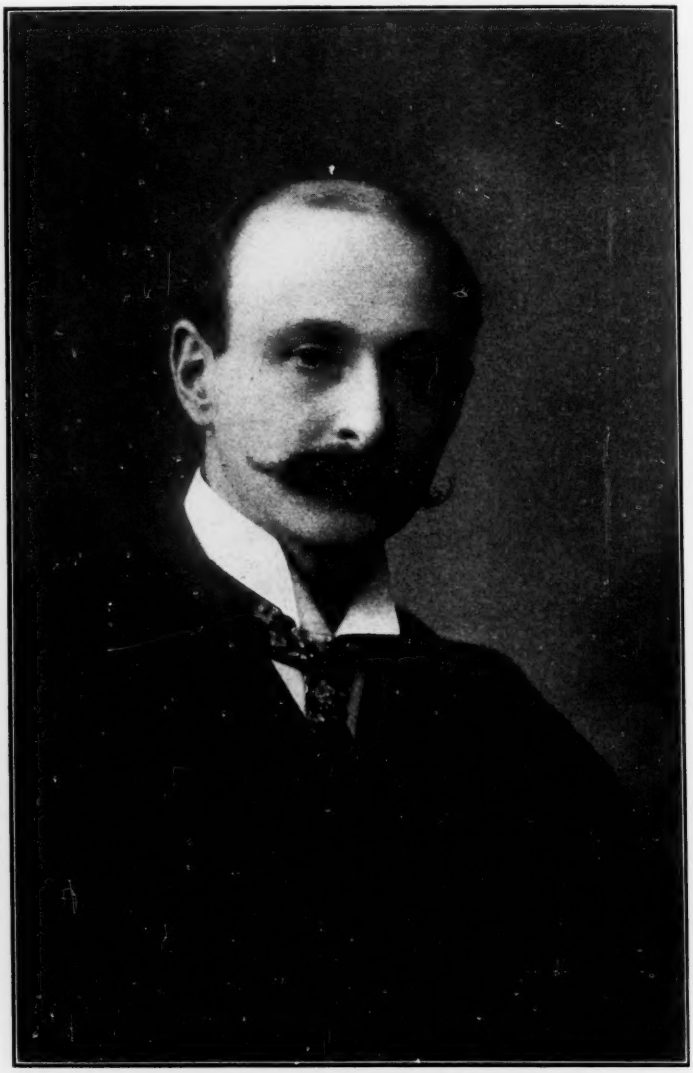
[1] This work under the joint authorship of the writer, H. G. Dyar and Frederick Knab, has been completed. Two volumes have been published, and the final two will shortly appear, under the auspices of the Carnegie Institution of Washington.

SIR PATRICK MANSON

Sir Patrick Manson, F.R.S., K.C.M.G., M.D., LL.D.; late physician and medical adviser to the Colonial Office; distinguished as a pioneer investigator and teacher; author of a standard work on Tropical Medicine; the discoverer of the transmission of filariasis by mosquities; the man who suggested to Ronald Ross his investigations of the transmission of malaria by mosquitoes.

SIR RONALD ROSS

Major Sir Ronald Ross, K.C.B., M.R.C.S., D.P.H., Hon. F.R.C.S., LL.D., Sc.D., M.D., F.R.S., professor of tropical sanitation, University of Liverpool and Liverpool School of Tropical Medicine; physician for tropical diseases, King's College Hospital; member of many sanitary committees; commenced special study of malaria in 1892 and later definitely traced the relations between malaria and mosquitoes; has since made tropical hygiene his life study and has conducted investigations of the highest importance in many parts of the world. He received the Nobel prize for his work in medicine in 1902.



PROFESSOR GEORGE H. F. NUTTALL

George H. F. Nuttall, F.R.S., M.A., M.D., Ph.D., Sc.D., Quick professor of biology, Cambridge University, England; chief editor and founder of the *Journal of Hygiene* and of *Parasitology;* an eminent bacteriologist and parasitologist, who early studied the biology of the *Anopheles* mosquitoes of England, and who has written much of the carriage of diseases by insects. Dr. Nuttall is an American by birth and was educated at Johns Hopkins University, and later in Germany, where he lived for a number of years.

DR. ARTHUR E. SHIPLEY

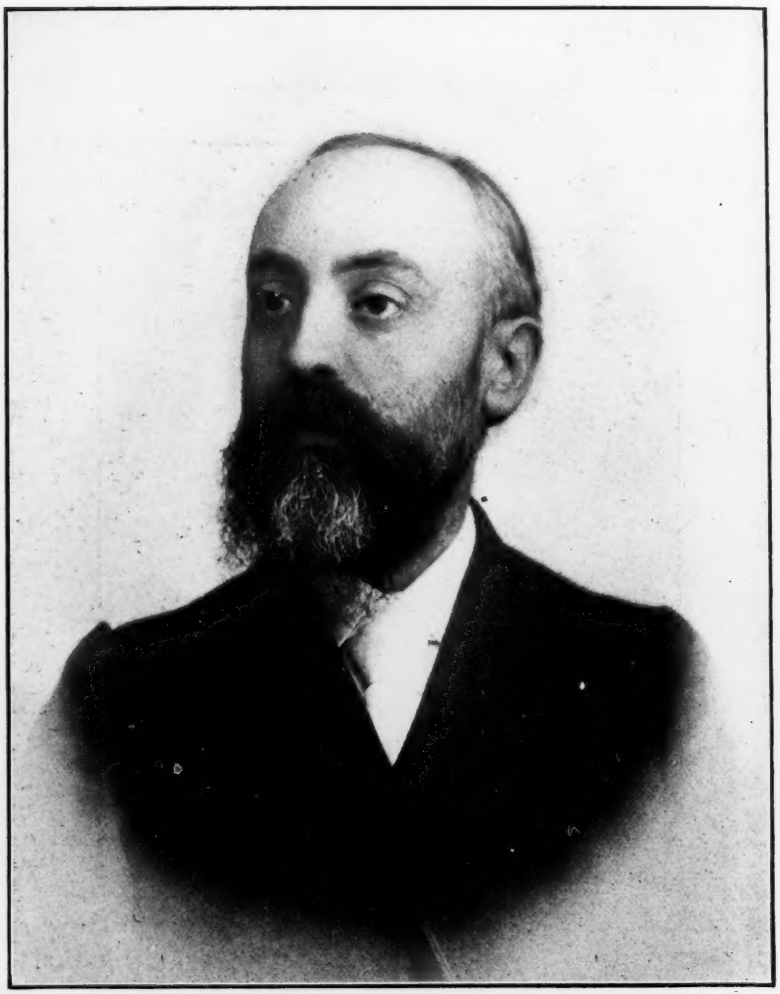
Arthur E. Shipley, F.R.S., M.A., Sc.D., master Christ's College, Cambridge University; reader of zoology; co-editor of *Parasitology* and of the *Journal of Economic Biology*. A broad, general zoologist who collaborated with Nuttall in some of his early studies on malarial mosquitoes of England, and who has written much on the subject.

PROFESSOR FREDERICK V. THEOBALD

Frederick V. Theobald, M.A., vice-principal of the Southeastern College of Agriculture at Wye, Kent, England; professor of economic entomology and zoology; author of the five-volume monograph of the Culicidæ of the world, issued by the British Museum of Natural History, the first two volumes of which were published, with a volume of plates, in 1901, and afforded a convenient method for the determination of species to the early workers in the transmission of disease by insects.

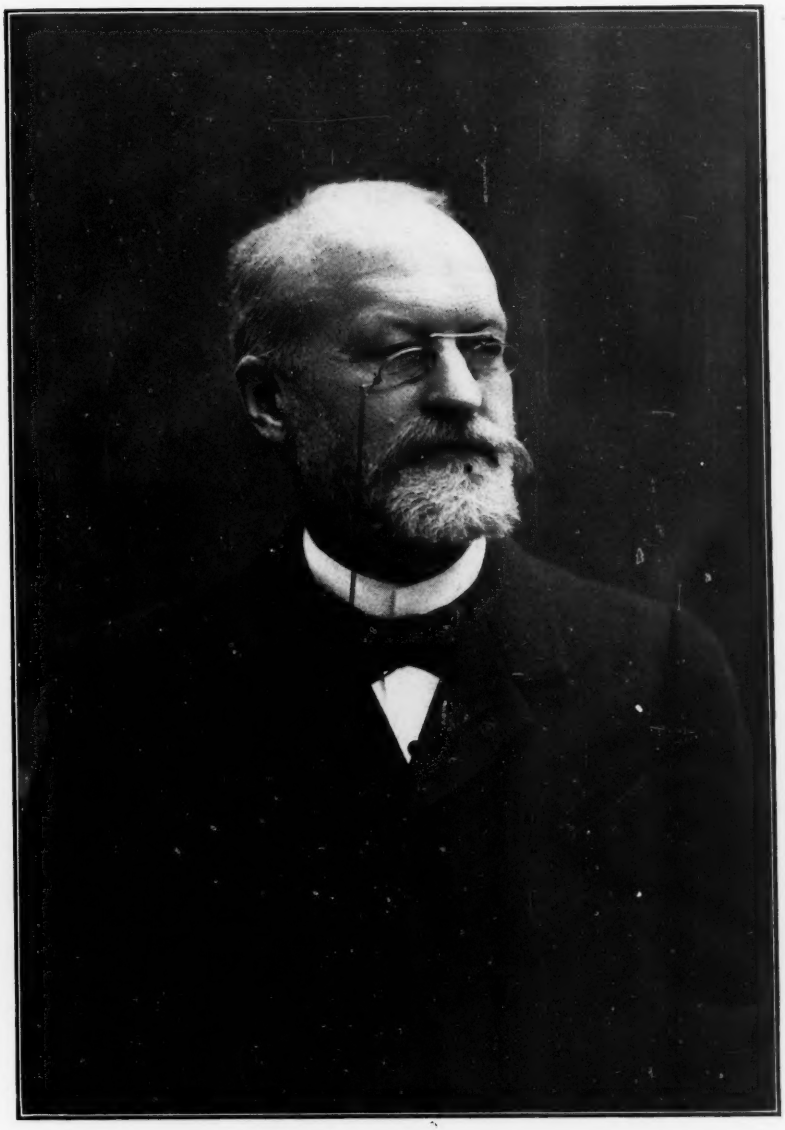
PROFESSOR G. B. GRASSI

Professor Dr. G. B. Grassi, professor of comparative anatomy and entomology in the University of Rome, and director of the institute of comparative anatomy; a very famous man of many-sided accomplishments, who, with Celli, studied the relations of malaria and the *Anopheles* mosquito, and was the first to point out that while early experiments with the carriage of malaria by mosquitoes of the genus *Culex* were negative, they might be successful with those of the genus *Anopheles,* just as Ross in India failed with his initial work with *Culex* and succeeded with the "dapple-winged" mosquitoes of the genus *Anopheles.*



PROFESSOR ANGELO CELLI

Professor Dr. Angelo Celli, director of the institute of hygiene, University of Rome, Italy. He was, up to the time of his very recent death, one of the foremost living workers in hygiene. His investigations and those of his colleagues and students were almost simultaneous with those of Ronald Ross in India, and largely through his personal instrumentality malaria has been enormously reduced in Italy. The Roman Campagna has once more been made habitable and the health of the peasants has very greatly improved.



DR. C. L. A. LAVERAN

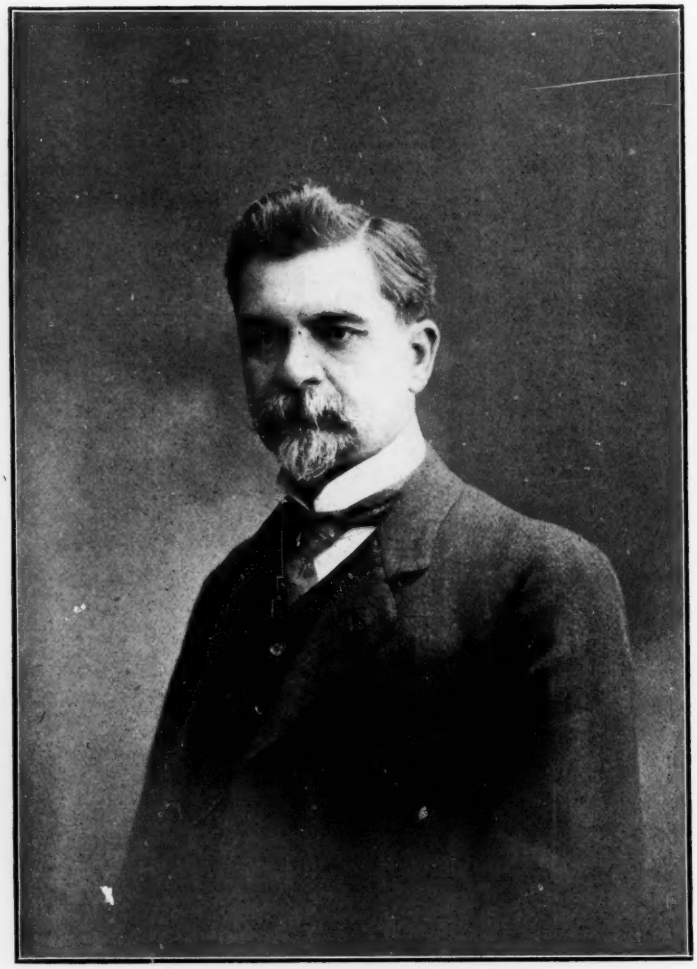
Dr. C. L. A. Laveran (ordinarily written A. Laveran), member of the Institute of France; member of the French Academy of Medicine; famous protozoologist; professor of protozoology, Pasteur Institute, Paris. He was the first to demonstrate the true cause of malaria and to describe the malarial parasite; is a very learned man in protozoology and has occupied himself much of late years with the subject of tropical diseases as they occur in the tropical and oriental French colonies.

PROFESSOR RAPHAEL A. E. BLANCHARD

Professor Dr. Raphael A. E. Blanchard (commonly known as Raphael Blanchard), professor of parasitology of the faculty of medicine in the University of Paris; director of the *Archives of Parasitology;* author of a standard two-volume treatise on medical zoology, and one of the most prominent figures in medical zoology to-day. He is the author of a large work on the natural and medical history of mosquitoes, published in Paris in 1905.

DR. EDMOND SERGENT

Dr. Edmond Sergent, director of the Pasteur Institute of Algeria; a man who, with his brother Étienne, chief of the malarial laboratory of the Pasteur Institute of Algeria, has made a special study of malarial mosquitoes and has devoted years to the problem of alleviating malarial conditions in Algeria.



PROFESSOR D. MARCHOUX

Professor D. Marchoux, microbiological laboratory, Pasteur Institute, Paris (section of tropical bacteriology); head of the French Commission to Brazil, which carried on monumental studies concerning the yellow-fever mosquito in Rio Janeiro, making many important discoveries.

DR. E. SIMOND

Dr. E. Simond, Pasteur Institute, Paris; was a member of the French Commission to Rio Janeiro, with Professor D. Marchoux, which conducted the magnificent investigations on yellow fever and the yellow-fever mosquito, and which confirmed the work of the U. S. Army Commission in Havana.

(*To be continued*)

THE MORAL DEVELOPMENT OF THE CHINESE

By Dr. FREDERICK GOODRICH HENKE
ALLEGHENY COLLEGE, MEADVILLE, PA.

THE political events which have transpired in China during the past two decades are symptomatic of profound social changes. Former changes of government had their origin primarily in a discontent with the reigning dynasty, without the further implication of a desire on the part of the people to participate directly in the government. When the ruling dynasty became corrupt and the oppression too severe, Heaven's displeasure was manifested, they thought, by allowing some powerful opponent to gain access to the throne and deliver the people. In case the new monarch was benevolent, he was gladly received and heartily supported. At the present time the educated people earnestly desire to take a definite hand in the changes; and there is an insistent demand on the part of Young China for an opportunity to take a permanent part in governmental affairs. These ideals have been but partially realized; but the general situation, of which they are a part, has aroused the interest of the civilized world, for they appear to indicate that China will, if given the opportunity, make a modern nation out of herself.

The ethical implications of the present movement are of outstanding significance, as they show that real moral advance is being made. An adequate understanding of this particular phase of the problem is best attained by a survey of Chinese moral development from the standpoint that genuine moral progress in any nation is dependent upon the advance from morality on the plane of custom and tradition to autonomous moral conduct.

The Chinese people may conveniently be divided into two principal classes, though the line of demarcation between them has never been drawn so hard and fast that it has not been possible for the individual to pass from one to the other. There are first the educated—those who read and understand the literature of the country, and who engage in some literary or official pursuit. Official standing has in the past very largely depended upon the literary degree held by the aspirant for office. In the second class are found the illiterate, who, because of their uneducated condition, have no knowledge of the literature of China, except such as they acquire indirectly. The leaders of China have come from the first class; the members of the second class, constituting a large percentage of the 426,000,000 of population, have been and are to-day living on the level of custom. Kueichu (custom) is with them a final authority, and when it is subject to alteration, as in the present period

of transition, the sanctions have been removed and confusion is apt to follow. For the Chinese of this class custom is followed, not because of the meaning that attaches to it, but because it is the established and recognized way of acting. The moral sanctions have grown out of a unique historical setting from which it is very difficult for the Chinese to dissociate themselves.

Of the earliest period of moral development little or nothing is known except by inference. The ancient past of China is enshrouded in myth and mystery,—a fact which, as is well known by students of history, is typical of all nations. This is the pre-historic period which is present both in the race and, figuratively speaking, in the individual. During this progress was made largely on an organic basis, or with conscious participation in the realization of certain immediate ends without further thought for the future.

The historic period begins definitely at 500 B.C., when Confucius collected, compiled and edited the chief literature of China.

> He took the records of remote antiquity, and sifted them, in such wise, however, as to exert in a most effective manner the influence of an editor, giving to the readers of all succeeding ages only that which he wished to produce its effect on the national mind.[1]

He was followed by Mencius (371–287 B.C.) about one hundred and fifty years later, who is known as the author of the "Works of Mencius." These two men and their disciples fixed the classic literature of China —the Six Classics and the Four Books—and by so doing determined the ethical conceptions of their people for over two thousand years.[2] From that time the educational ideal was not the creative production of independent literature, but the memorization and interpretation of the classic literature. In this way the classic literature of China took the same place in the development of China which the Vedic literature held in India. Serving as a standard, it frustrated that spontaneous development of thought which is a *sine qua non* of higher moral progress. Not only was the second class of people in China under the sway of custom, but the educated people and the leaders were also completely dominated by ideals that had been created centuries before. The enslavement to custom became complete, when the philosopher Chu Hsi (A.D. 1130–1200) of the Sung Dynasty fixed the interpretation of the classics by his commentaries. It was so thorough that signs of genuine liberation have been present for only about two decades, and even at the present time the majority of Chinese scholars accept the interpretation of the philosopher Chu without further question.

In addition to the restraining effect of the classic literature, the re-

[1] W. A. P. Martin, "The Lore of Cathay," Revell Company, N. Y., p. 170.

[2] The sixth Classic is the "Book of Filial Piety," which is sometimes omitted in the enumeration.

ligious teachings of Lao Tzu, the founder of Taoism, also discouraged individual initiative and thereby moral progress. The sage Lao Tzu, who was a contemporary of Confucius, found the great principle of life in the "Tao." This term "Tao" has an abstruse and mysterious connotation, having been rendered "Reason," "Nature," "The Universal Order," "The Way," "God." The following citation from the fourteenth chapter of the "Tao-Teh-King" will show the elusiveness of its meaning.

> Looked for but invisible, it may be named "colorless";
> Listened for but inaudible,—it may be named "elusive."
> Clutched but unattainable—it may be named "subtile."
> These three can not be unravelled by questioning, for they blend into one.
> Neither brighter above nor darker below.
> Its line, though continuous, is nameless, and in that it reverts to vacuity.
> It may be styled "the form of the formless"; "the image of the image-less"; in a word the "indefinite."
> Go in front of it and you will discover no beginning; follow after it and you will perceive no ending.
> Lay hold of this ancient doctrine; apply it in controlling the things of the present day, you will then understand how from the first it has been the origin of everything.
> Here indeed is the clue to the Tao.[3]

This "form of the formless" and "image of the imageless" is viewed as the creative, organizing principle of the universe, and should not be hindered in its working. Lao Tzu "discouraged above all the assertiveness by which any individual would attempt to magnify his importance or to interfere with the normal quiet and rational development of things."[4] The Tao-Teh-King says:

> The world's weakest drives the world's strongest.
> The indiscernible penetrates where there are no crevices.
> From this I perceive the advantages of non-action.
> Few indeed in the world realize the instruction of silence, or the benefits of inaction.[5]

These and other available passages from the "Tao-Teh-King" show clearly that Lao Tzu also made his contribution to a more complete enslavement to custom.

The introduction of Buddhism into China during the reign of the Emperor Ming-Ti (A.D. 58–76) did little or nothing toward stimulating a genuine development of the moral ideal. Buddhism in its inception and development has consisted almost entirely of methods whereby the individual may rid himself of the evil effects of desire. Its influence has

[3] C. Spurgeon Medhurst, "The Tao Teh King," Chicago, Independent Book Co., p. 24 f.

[4] Paul S. Reinsch, "Intellectual and Political Currents in the Far East," p. 123.

[5] C. Spurgeon Medhurst, "The Tao Teh King," p. 75.

been quite largely negative, for it takes men out of society. Abstract and monotonous contemplation according to definite rules is typical of its techniques. Such inwardness is fatal to the genuine autonomy of higher morality. So far from leading men forward into higher cultural life, it simply burdened them with further groups of customs. Owing to the fact that discrimination has not set in, large numbers, if not all, of the Chinese are at one and the same time Confucianists, Taoists and Buddhists.

In all this the ethical ideal which was emphasized by Confucius and interpreted later by the philosopher Chu has had a profound influence on the majority of the Chinese. It is succinctly expressed in the Great Learning in the following words:

> **The ancients who wished to promote virtuous conduct throughout the kingdom, first ordered well their own states. Wishing to order well their own states, they first regulated their families. Wishing to regulate their families, they first cultivated their persons. Wishing to cultivate their persons, they first rectified their hearts. Wishing to rectify their hearts, they first sought to be sincere in their thoughts. Wishing to be sincere in their thoughts, they first extended to the utmost their knowledge. Such investigation of knowledge lay in the investigation of things.**[6]

This descending series should be approached from below, so that it involves ascent rather than descent. Broad knowledge of self and others is the foundation, and upon this are built in succession sincere thoughts, rectified minds, practise of personal virtue, well regulated families, well ordered states, and finally the promotion of practical virtue throughout the kingdom. Such ideals challenge the admiration of all men and might well stimulate autonomic conduct. Unfortunately, as we have indicated, the whole series rested on a basis of convention, so that it was little more than mere form.

The situation is similar in the instance of the five social relationships—of husband and wife, father and son, brothers, prince and officer, and friends. They do not rest on a rational basis, but have become incrusted with layer upon layer of custom. An illustration or two will serve to elucidate this point.

In case of severe illness of a parent, there has been a generally held belief among the Chinese for thousands of years that a cure can not be effected, unless a piece of the flesh of the son is cooked and then eaten by the parent. Naturally cases of this sort are not everyday occurrences, but they have the sanction of custom and in extreme instances are adopted. References to this have frequently appeared in Chinese papers. Dr. Smith assures us that he has become "personally acquainted with a young man who cut off a slice of his leg to cure his mother and who exhibited the scar with the pardonable pride of an old soldier."[7] He also

[6] "The Great Learning," Introduction, p. 4.

[7] Arthur H. Smith, "Chinese Characteristics," New York, 1894, p. 178.

cites the experience of Abbé Huc. Having occasion to send a messenger, the latter thought that a Chinese schoolmaster who was working for him might desire to improve the opportunity to send a letter to his old mother whom he had not seen for four years. The schoolmaster, upon hearing that the messenger would leave soon, called one of his pupils, saying: "Take this paper and write me a letter to my mother." M. Huc was surprised and proceeded to inquire whether the boy was acquainted with the teacher's mother. Receiving a negative reply, he said: "How then is he to know what to write?" The schoolmaster answered: "Doesn't he know quite well what to say? For more than a year he has been studying literary composition, and he is acquainted with a number of elegant formulas. Do you think he does not know perfectly well how a son ought to write to a mother?"[8] The boy returned the letter to his teacher sealed, and it was thus forwarded. It would "have answered equally well for any other mother in the Empire."

The tremendous population of China is also largely the outgrowth of the requirement of Confucianism that the son shall worship at the grave of his deceased parents. No greater honor can come to a woman than to be the mother of a son. If she fails of this, she is not infrequently obliged to make room for another who can bear a son, for no man is content until he has a son who can worship at his grave. Until this superstition is brought under the light of reflection, excessive propagation will continue and with it moral development will be retarded.

But withal the situation is somewhat better than it would appear. Fortunately for China, agencies have been at work in the past that were operative in the right direction. Of these, we may distinguish both rationalizing and socializing forces. The value of these agencies as factors in promoting moral development depends largely upon their advancing *pari passu*. Rationalizing forces make for systematic conduct based upon natural law as a result of reflection and scientific control; socializing forces contribute to a more equal distribution of the concrete things that satisfy the health, wealth, sociability, knowledge, beauty, rightness, and religion desires of the human being. Two men stand out very prominently in Chinese history, previous to the present reform movement, as making a serious attempt to break away from custom and advance the moral condition of the Chinese. Their efforts were not crowned with success at the time, but they served to keep alive the spark of progress which was all but extinguished.

The first was Wang An-shih of the Sung Dynasty, A.D. 1055–1085. Realizing the poverty -stricken condition of his people in contrast to their prosperity under the sage emperors Yao and Shun and Chou Kung, he was very anxious to do something for them. The Emperor Shen-

[8] *Ibid.*, pp. 180, 181.

Tsung asked him one day, "If I were to make you chief minister of state, what would you do?" "I would change the customs and institute reforms," Wang replied.[9] Thereupon the emperor formed a board of three officials, whose task it was to investigate the condition of the country and to suggest where improvement might be made. This board sent out officers throughout the country "to report upon the nature of the soil, where watered and where not, where it was rich and where it was poor," and to give other information that might help to alleviate the condition of the farmer. The outcome of this movement was the introduction of four reforms:

1. The first was a state monopoly of commerce. The commerce of the country was to be carried on by the state instead of by the people. The plan is briefly summed up by MacGowan as follows:

> **The taxes for the future should be paid in the produce of the district where they were levied, and the state should furnish funds to buy up what was left. This should be transported to different parts of the country where a good market could be found and sold at a reasonable profit. Thus would the state be benefited and the poorer classes be saved from the oppression of the rich, who had been in the habit of buying cheaply and selling at exorbitant prices.**

This reform included a scheme for state advances to cultivators of the soil. The government loaned money to all farmers in the spring when the seed was sown, and a definite sum of money was returned in the fall by the farmers. These loans netted about two per cent. per month.

2. The second reform was an attempt to equalize taxation. To this end the country was divided into Fangtien, or square fields, one thousand steps on each side, and the taxes on each were appraised in the ninth moon, "according to the general average of the producing power of the soil, which was divided into five classes according to its fertility.[10]

3. The third reform measure introduced militia organization. Every ten families were organized into a group with a headman called a Pao-chang; five such groups, or fifty families, were formed into a larger group with a higher commander; and ten of the larger groups formed a district. All homes having more than one son were obliged to give one in service to the state. The members of the militia were allowed to remain at home in time of peace, but when war or disturbance threatened they were called out by the headmen. Modifications of this reform were later used in the Ming and Tsing Dynasties.

4. The last of the great reforms of Wang An-shih was that of providing for the construction of public works by means of a family tax. He wished to remove the abuses that grew out of compulsory labor. His plan was to rate the tax required in accordance with the property of the fam-

[9] J. MacGowan, "Imperial History of China," Shanghai, 1906, p. 383.

[10] John C. Ferguson, "Wang An-Shih," an article in the *Journal of the North China Branch of the Royal Asiatic Society*, Vol. 35, p. 72.

ily. The method which was devised to secure accurate information for this purpose caused great confusion and misery.

On the whole, Wang An-shih's attempted rationalization and socialization of conduct was not successful. He was unwise in some of his efforts, and was vigorously opposed by Sz-ma Kwan and other prominent officials at the time. Nevertheless, certain permanent benefits from his reforms came down to later generations, and, what is more, his effort remains as one of the outstanding attempts to break the shackles of custom.

A second great moral reformer who broke with custom was Wang Yang-ming, or Wang Shou-jen. He inculcated doctrines which have had a profound effect upon the Japanese during the past one hundred years, and which are to-day wielding a great influence upon the Chinese mind.

The date of Wang's life is approximately 1472–1528.[11] As compared with contemporary European history, he lived in the period of the great maritime discoveries and at the beginning of the Reformation. He was fearlessly propounding his views in China shortly before Giordano Bruno, after a life of restless wandering in search of truth, suffered martyrdom for his philosophic exposition of the universe, and about a century previous to Hobbes, Descartes and Spinoza.

The most important thing about his philosophy is that it does not unreservedly advocate the interpretation given to the classics by former scholars, but insists on a rationalization which gives room for progressive adjustment. For him, human life, both in the race and in the individual, was a developing thing. He insisted that the highest values of life are realized only through development, and that apart from development life must prove a miserable failure. That he failed to approach the problem from the modern scientific view does not detract from the fact that he actually got a glimpse of the developmental character of human institutions, and that such a standpoint will invariably result in moral progress if thoroughly assimilated.

The one sentence, "My nature is sufficient," gives the foundation upon which the whole structure of his philosophy and ethics rests. Man's mind holds the key to all the problems of the universe. Nature—experience, we would probably say—is the stuff out of which the universe is made. This nature may be viewed from different aspects, but in whatever way it is approached, it is just this one nature.

> Referring to its form and substance, it is Heaven; considered as ruler or lord, it is Shangti (God); viewed as functioning, it is fate; as given to men, it is disposition; and as controlling the person it is mind; manifested by mind it is called filial piety when it meets parents, and loyalty when it meets the prince. Proceeding from this on, it is inexhaustible, but it is all one nature.[12]

[11] Vide *Monist*, Vol. XXIV., No. 1, p. 17 ff.

[12] Wang Yang-ming, "Philosophy," Book I., p. 23. This reference is to the Chinese edition published by the Commercial Press, Shanghai.

If nature at large be designated as the macrocosm, then human nature is the microcosm, and for Wang human nature was the human mind. He was taking recreation at Nanch'en, when one of his friends pointed to the flowers and trees on a cliff and said, "You say that there is nothing under Heaven outside the mind. What relation exists between my mind and those flowers and trees on the high mountain, which blossom and drop of themselves?" Wang replied: "When you cease regarding these flowers, they become quiet with your mind. When you see them, their colors at once become clear. From this you can know that these flowers are not external to your mind." This is undisguised idealism, in which the microcosm creates as truly as does the macrocosm. In the great all-pervading unity of nature the most differentiated, highly specialized portion is the human mind. It manifests the only creative ability that man can really know. Wang said again and again that it is *ab initio* law, that it is the embodiment of the principles of Heaven. Thus its very essence is natural law; but not in any partial, superficial sense. There are no other principles operative anywhere, for the mind is so all-embracing that it has no internal and external.

The influence of this point of view upon Wang's ethical theory and practise was profound. He held that it is not necessary to go to the classic literature to get a knowledge of fundamental ethical principles, for the human mind has these principles within itself. Intuitive knowledge of good is to be identified with moral principles. He who would have accurate information regarding right and wrong can get it from the intuitive faculty. The highest good consists in developing it to the utmost. It is to the details of right and wrong and to changing circumstances as compasses and squares are to squares and circles, and measure to length and breadth.

> The changes in circumstances relative to details can not be determined beforehand, just as the size of the square or the circle, and length and breadth can not be perfectly estimated. But when compasses and squares have been set, there can be no deception about the size of the circle or the square, and when the rule and measure have been fixed there can be no desception about length or shortness. When the intuitive faculty has been completely developed, there can be no deception regarding its application to changing details.[13]

Wang is to-day read extensively by Chinese students, and will probably influence the Chinese as much as he has the Japenese. He has the advantage over many other rationalizing and socializing forces of the present day in that his point of view is a direct product of the Chinese mind and therefore strikes a sympathetic chord in the mind of the Chinese scholars. As a rationalizing and socializing factor in the development of Chinese morals it exhibits the following doctrines:

[13] Wang Yang-ming, "Philosophy," Book III., p. 61 f.

1. Every individual may understand the fundamental principles of life and of things, including moral laws, by learning to understand his own mind and by developing his own nature. This means that it is not necessary to use the criteria of the past as present-day standards. Each individual is able to determine for himself what is right and wrong. Like Protagoras among the Greeks, Wang Yang-ming among the Chinese held that "Man is the measure of all things."

2. On the practical side, Wang taught that every individual is under obligation to keep knowledge and action, theory and practise together, for the former is so intimately related to the latter that its very existence is involved. There can be no real knowledge without action. The individual has within himself the spring of knowledge and should constantly carry into practise those things that his intuitive knowledge of good gives him opportunity to do.

3. Wang taught that heaven, earth, man and all things are an all-pervading unity. The universe is the macrocosm, and each human mind is a microcosm. This naturally leads to the conceptions, equality of opportunity and liberty, and as such serves well as the fundamental principle of social activity and reform.

Turning to the present reform period, we find two further types of forces at work in the moral development of the Chinese. Of these the first is the work of the modern Chinese reformers, and the second the impact of outside influences upon China. While these are discrete in certain aspects, they coalesce at many points. The ends sought do not differ greatly. The Chinese reformer of the present day recognizes the value of occidental techniques and of the principles of our civilization. This entails a rationalization and socialization of conduct which destroys the value of many Chinese customs and stimulates reflection on problems of conduct.

Among the principal Chinese reformers of the last two decades we may name K'ang Yu-wei, Liang Ch'i-ch'ao, T'an Ssu-t'ung, Dr. Sun Yat-sen and the men associated with them. Almost from the first their object was to rid China of the abuses of an absolute form of government. K'ang Yu-wei, Liang Ch'i-ch'ao and T'an Ssu-t'ung were intimately connected with the "hundred days of reform" and the "coup d'état of 1898," when an attempt was made to inaugurate a milder, more liberal form of government. T'an was executed the same year, while K'ang Yu-wei and Liang Ch'i-ch'ao escaped. Dr. Sun was connected with a movement in Canton against the government in 1895, as a result of which he became a fugitive. He returned to his country in the autumn of 1911 and became Provisional President of China and a prominent member of the People's Party (Kuo-ming-tang). These men and their associates have done much to awaken an interest in republican principles of government, social reform and individual initiative. Liang

Ch'i-ch'ao has been Minister of Justice under President Yuan Shih-kai and also editor of the *Yung Yen Pao* ("Justice"), published in Tientsin twice a month. K'ang Yu-wei carried on reform work from Japan. All of these men had high ideals for their country—ideals which have been but partly realized owing to the condition of the masses of the people and to official opposition.

As far as the impact of outside influences is concerned, western education has been a strong factor in showing that the old ideals and techniques are inadequate, as compared with those of western countries. Students have gone to England, Germany and America, and have had ocular demonstration of the prosperous social and economic condition of the people there. They have seen democratic principles practically applied; and the fundamental principles of western civilization, as well as the scientific attitude toward the problems of life, have been acquired by them in the colleges and universities. Returning to their country, they have by example and precept promoted individualism and social justice. Some have gone to Japan and have seen what great changes are taking place under the influence of the modern movement there. Other students, upon entering schools established by Europeans and Americans under the supervision of various missionary societies, have become acquainted with western ideals for the individual and society. They, too, have taken an active part in propagating ideas that stimulate advance from custom into reflective morality. The influence of these factors, and the sad experiences of the Boxer uprising, were so pervasive that Tzu Hsi, the Empress Dowager, upon the advice of Yuan Shih-kai and Chang Chi-tung, issued a decree in 1904 abolishing the old system of examinations and making graduation at one of the modern colleges the only recognized path to official employment. The abolition of the old system of education and the introduction of new ideals in the schools throughout China was one of the principal causes of the overthrow of absolutism and the founding of the Republic. And since the founding of the Republic, the old conception of the education as an instrument for making loyal subjects of the Emperor has, according to the ministry of education, been changed into an attempt to utilize education as a means of cultivating moral and virtuous character for the purpose of qualifying both men and women for citizenship.

The commercial relations existing between China and foreign countries since the forced introduction of opium have also furthered the moral development of China. The development of commerce, industry and art affects the moral life in three important ways. (1) "It gives new interests, and opportunity for individual activity."[14] (2) These increased opportunities bring forward the question of values. Are all the new activities good? If so, what can be done to promote them?

[14] Dewey and Tufts, "Ethics," p. 153.

If not, what shall be done to hinder their progress? (3) The development of commerce raises the question of distribution. Are the goods distributed in a just manner? Are all the people of the country receiving their equitable portion? Manifestly the introduction of modern commercial and industrial methods will in time involve a tremendous change in the economic life of the Chinese. There are indications in China to-day of the beginning of an industrial revolution similar to the one in Europe in the second half of the eighteenth century. Railway transportation of commercial products has affected thousands of wheelbarrow coolies. The introduction of cotton and wool clothing has thrown large numbers of silk weavers out of employment. Modern machines are rapidly being introduced in the larger and more accessible cities and will soon follow in all parts of the country. Situations of this sort give rise to urgent moral problems and result in moral advance.

While educative and commercial forces have been operative, the introduction of Christianity into China through missionary enterprise in chapels and hospitals, has also greatly furthered moral progress. Christianity has called attention to moral evils and has created a sense of sin and unworthiness which has helped many to break away from pernicious customs. It has engendered a more adequate appreciation of the ideals of brotherhood and social justice and thereby has stimulated new conceptions of the relation of man to man, and of mutual responsibility. It has emphasized the worth of the soul, and in so doing has given added worth to individual life. Thousands have accepted the principles of Christianity—some consciously, other unconsciously. Many of these—especially women—have been encouraged to learn to read, and the ability thus acquired has served not only the immediately desired end of reading the Bible, but has also widened the intellectual horizon and created new and larger interests. Christianity has probably done more during the last hundred years than all other forces combined to liberate Chinese women from the shackles of custom.

China has entered a period of transition comparable to the period of the Sophists of ancient Athens, the Renaissance and the Reformation in western Europe in the fifteenth and sixteenth centuries, the industrial revolution of the eighteenth century, and the French Revolution. Old landmarks are being swept away; foot-binding will probably never reappear, and it is highly probable that opium will be effectually driven from the country. But certain old landmarks will be reinstated —in a modified form, perhaps, though not necessarily. At a feast given in the city of Nanking shortly after the formation of the Provisional Republic of China, one of the prominent officials of Sun Yat-sen's government informed the guests that "Confucianism is forever dead." Since that time it has received official recognition from President Yuan Shih-kai, and the titles and privileges which the lineal descendants of

Confucius had enjoyed under the Manchu dynasty, including the title of "Holy Duke," have been restored. China will not make the transition from customary morality to reflective morality in a few years, nor can a truly republican form of government be established there prior to a general rise of educational conditions. Japan awoke from her sleep in 1854 as a result of the coming of Admiral Perry, and soon thereafter instituted a campaign of reform. The Japanese have now become aware of the fact that they confront a great problem, and are to-day in the very act of discovering and confirming rational standards of conduct. Custom and reflection are waging mighty battles there to-day, for the modern movement is in full swing. In China the rational and social forces which have been set in motion should be allowed to operate until that great country has taken the necessary step from customary to reflective morality and has taken its place among the nations of the world.

WATER CONSERVATION, FISHERIES AND FOOD SUPPLY[1]

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A National Problem

NO subject of national economy has broader significance to-day than that of water conservation. Every one knows that unrestrained floods wreak yearly an enormous destruction of property. Our flood losses have, indeed, been computed at 200 millions of dollars per year. All are aware that the demands of power are contributing to the gradual exhaustion of our coal deposits, while the possibilities of deriving power from the flow of water remain at our grasp. A single water power of recent development has been estimated to effect a yearly saving of 365 thousands of tons of coal even at the very outset of its operations. Every intelligent conservationist, whether farmer, business man or student, observes that over the country-wide the soils are being impoverished by the wash of surface waters, and the fertile lands are being carried away to enrich the sea. If we seek figures again, we are told that one and one-quarter billion tons of silt are deposited annually in the Mississippi River, one half of which serves to impede navigation and the other half to extend the state of Louisiana out into the Gulf of Mexico. One who has observed the soils of the middle west in a state of productivity, and again the same or similar soils in the form of useless and rapidly broadening flats at the tip of the delta of the Mississippi, can not but be deeply impressed with the ultimate wastefulness of permitting the transfer of soils from a place where they are useful to a place where they are injurious.

If we view only the most obvious losses, we begin to realize the significance of water conservation; but still we may be far short of comprehending the magnitude of the forfeit that we regularly pay for an inadequate policy or practise with regard to our supplies of water. While agriculture, and consequently the flood supply of the future, may suffer from the erosion and leaching of soils, economists assure us that there are immense areas of farming lands which are diminished in production, because at the critical season they lack the moisture that might, with different methods of tillage, have been conserved in the soil from

[1] Published by permission of Dr. Hugh M. Smith, United States Commissioner of Fish and Fisheries; the author alone is responsible for the opinions expressed.

the time of water surfeit.[2] Again, while rivers become torrential and destructive, submerging valuable farming lands and taking a toll of property and lives, yet, because the spring waters were allowed to pass quickly away unstored in soils or reservoirs, these same streams at other periods are found to be so restricted in volume and so checkered in course by accumulated drift that the pathways of natural transportation are more or less effectively closed.

It is clearly within reason to say, then, that no other form of material waste can be measured against the stupendous aggregate resulting from the failure to conserve and control and utilize the available supplies of water. It is easy to understate the importance of water conservation, while overstatement would almost seem beyond our powers. Water-power development and the conservation of coal deposits, soil conservation and the reclamation of arid and semi-arid lands by irrigation or by "dry-land" methods, reforestation and flood control, reclamation of overflowed lands and maintenance of inland waterways, stream pollution and fisheries—these several objects, each of great importance by itself, are all, in large measure, aspects of the one comprehensive problem. Each of these admitted obligations has a direct relation to our duty of storing the available water supply in soils or in reservoirs, of regulating its flow from source to sea, and of utilizing it to the maximum at all stages, for power and navigation, for farms and forestry, for sanitation and fisheries. Stated in this way, with all its manifold bearings, the general problem may assume an exaggerated appearance of complexity. Surely water conservation is broad in its relations, and surely its complete realization will not be attained in a day or in a generation, and yet the stages of the solution of the entire problem may be just such matter-of-fact steps as we are repeatedly taking in the ordinary course of practical progress.

Fisheries have been named just above as related to water conservation. The relation might be obvious and yet insignificant: this may be called the prevailing impression. Fresh-water fisheries have been practically entirely disregarded in connection with the conservation of water; nevertheless, it can, I believe, be made apparent, first, that the possibilities of food-supply from fresh-water fisheries in public waters will be realized only as water conservation becomes a reality, and, second, that the proper development of fish-raising as a principal or incidental occupation may, in a very practical and simple way, promote the general object of water conservation.

[2] Wall, Judson G., "Flood Prevention and Its Relation to the Nation's Food Supply," *Science*, N. S., XL., No. 1019, pp. 44–47, July 10, 1914; signed as chairman of the committee on soil erosion of the Social and Economic Section of the American Association for the Advancement of Science. A strong and suggestive paper, but without mention of fisheries.

Fisheries, a Matter of Concern

It is not very difficult to understand why the fisheries so rarely receive mention in discussions of water conservation. In the general mind, fresh-water fisheries do not rank with the bases of industry so much as with the means of recreation. Some industries assert themselves by figures, but, in the way of statistics, the fresh-water fisheries have not the striking appeal of established agricultural industries: statistically speaking, we can not now compare fish with potatoes. Primarily, however, people do not think of fisheries in connection with water conservation, because it is not generally understood that the two have a connection worthy of consideration. It is worth while to inquire if there is a relation of real significance.

The value and the meaning of the fish resources to the people of the United States depends upon the contribution of an important element of food supply and the offering of a peculiar field of recreation. Perhaps, in the mind of the average man of this country, the one benefit would be regarded in equal measure with the other. This is not an inevitable or universal condition; it is an incident of the present state of the fishery. There are countries where the taking of fish for sport is almost unknown, but where the fish resources are regarded as of vital moment to the welfare of the people, and where the capture and the preservation and the distribution of fish are industries that are recognized to be of elemental importance, in similar fashion to agriculture. In many other counties fish forms much more of a staple food than with us, and a far larger proportion of the people find a livelihood in the fishery industries. Our people are not essentially different from others in their appetites and bodily needs.

The basic claim of fisheries to public recognition rests upon the part that fish must play in the future food supply of the country; but how is it to be said what this future part will be? Certainly the future is not to be measured by the present. We know that the fisheries of our principal streams are in a state of depletion except in rare localities, and we know, though we are much less conscious of this fact, that the compensatory development of commercial fishery resources in the rivers, by artificial propagation or by other well-directed means, is relatively slight. Nearly all of our thought, all of our energies, all of our expenditures, have been directed to promote the abundance of game fishes, and perhaps we might have to confess that we were thinking not so much of providing something to eat as of supplying something to catch.

A little reflection, a little common sense, will suggest to us that neither the present nor the past condition of the interior fisheries foreshadows the future. As our country becomes more thickly populated, as the capacities of the lands become more and more severely taxed, as the prices of meats mount higher, it is inevitable that we shall look

more to the possibilities of our waters to supply us with food. The true fish conservationist should look forward to something more than the preservation or the protection of existing fisheries: in fact, his ideal may well be a development of fishery resources that is now scarcely conceived in the public mind. We do not want, in fisheries, a restoration of the past, but the inauguration of a future.

Floods and Fishes

On every hand there are explanations of the diminution of the number of food-fish of the rivers; but surely this can be ascribed only in part to the causes of over-fishery or to other direct acts of man. One ultimate explanation, it may be confidently stated, will be found in those very conditions which have indirectly affected the flow of our great streams in so disastrous a way as to create a demand upon the government for the storage of waters and the regulation of the flow of streams. Deforestation, denudation, drainage—to these causes, among others, are ascribed the extreme flood conditions ensuing upon the development of the country, and to these likewise may be attributed a significant change in the condition of our rivers as bearing upon the natural reproduction and sustenance of fish.

The occurrence of spasmodic floods, of comparatively short duration and separated by intervals of extreme low water, have a deleterious effect upon fish life in manifold ways. The first realization of this fact comes with the observation of enormous numbers of young fish left in the overflow ponds isolated by the recession of the flood. The significance of the observation is not in any way grasped if we suppose that these innumerable fish were simply carried out by chance and left by a similar chance. The real phenomenon is this. The flood occurred when the breeding fish were seeking the shallow and warmer waters for the location of their nests and the deposition of the eggs. When the young from these eggs, together with the adults, are left to starve and suffocate and die in the disappearing or diminishing pools, we see, not the loss of a random proportion of the fish life of the stream, but the actual decimation of a generation. Consequently, it should be esteemed of high importance to reclaim and restore to the rivers the fish thus abandoned otherwise to destruction. Such overflow ponds are now, to be sure, a common source of supply for government and state departments seeking fish for general distribution. It is better that the "lost" fish should be used for some good purpose, rather than left to die, but, that our impression may not be confused, it should be remembered that the conservation of fish in the particular stream is regarded and promoted only in so far as the greater part of the fish are returned to the river, and this is done in some cases.

It may not and does not always occur that the flood comes just before the fish have begun to nest. It may occur while the eggs are yet

unhatched, and where they have been placed in favored locations along the shores of the streams at low stage. We may then only guess at the destruction which must ensue when the entire condition is suddenly and drastically altered by the untimely arrival of the flood. Clear shallow waters, warmed by the sun, are in a brief space of time replaced by deep and turbid torrents, and the very banks and bottoms are torn away or displaced. To fish life another catastrophe has occurred.

It will not be maintained that any practicable scheme of control, however comprehensive, will prevent altogether the occurrence of high and low stages, but it has been attempted to show that the regulation of the flow of rivers has a very direct relation to the reproduction of fish.

Without successful reproduction we certainly can not have fish; but the abundance of fish, even under natural conditions, does not depend alone upon successful propagation. The young fish must survive and grow, and for these ends their requirements are similar to those of other animals, namely, food and oxygen, principally. Likewise, just as in the case of other animals, the food is derived ultimately from the essential chemical constituents through the intermediation of plants. The rains that wash the soils bring the needed constituents into the streams, but not necessarily in a form available for animal life; for them to become available requires time, sunlight and vegetation.

It is clear that excessive turbidity and extreme conditions of flood have the most direct bearing upon the conditions of food supply for fish. Not only is this the case, but extreme low stages may have a highly deleterious effect. The first result of the decomposition of organic matters brought into the water is the exhaustion of the oxygen supply, and this may proceed to such a point as to make the environment distinctly unfavorable for any form of aquatic animal life. The beginning of mortality among the animals, whether smaller or larger forms, by adding to the amount of decomposing material, only serves to increase the rate of deoxygenation of the water and to accelerate the course of destruction. Such a catastrophe can be checked or restricted as to its duration or territory of action only by the development of sufficient plant-life to effect a restoration of equilibrium, or by the diluting and cleansing effect of an increased flow in the stream. Some of the instances not infrequently reported of enormous mortality of fish in portions of rivers just below cities and in times of low water are most certainly due to this very fact of a disturbance of the established equilibrium between sewage, plants and animals, with a consequent mortality that is self-accelerative to the point of inducing a conspicuous catastrophe.

Conservation of Favorable Environments

There has been developing in recent years almost a new science which deals with the gas-content and the chemical analysis of water,

as affecting the value of the water as a habitat for animal life. Surprisingly interesting observations and inferences have been made, but nothing has been learned to gainsay the statement that, to realize anything like the potential abundance of fish-life in our streams, it is necessary to approach more nearly to a condition of stable equilibrium. The primary difference between a natural stream or pond and an artificial fish-cultural pond is that in the latter the conditions are relatively stable and subject to a degree of control.

It is not to be supposed that water-power development has no relation to fisheries except as expressed in the presence or absence of a fishway. It may be inferred from what has previously been said that artificial pools at intervals in the course of a stream, entirely apart from the question of fishways, may bring substantial advantages in providing relatively extensive feeding and breeding grounds for fish, in affording conditions of relative stability, and in tending indirectly to make more uniform the conditions prevailing in the streams below or between the pools.

It becomes increasingly clear that all matters affecting the flow of streams have the most vital bearing upon the promotion of fishery resources, as touching reproduction, nourishment and respiration.

The artificial propagation of fish, even under present conditions, is producing results of significant value; but it is no disparagement of such operations to venture the prediction that the future will show that the effective conservation of fishery resources depends upon the coupling of intelligent fish-culture with comprehensive and well-advised conservation of the environment favorable both to the natural propagation of fish and to the multiplication of the essential elements of food supply.

The requirements of reasonable brevity prevent our enlarging upon the relation of fisheries to the various other phases of the general scheme of water conservation. Just a few suggestions may be ventured. It has been advocated in at least one state that the reclamation of overflowed lands should be so administered as not to eliminate entirely the favored breeding grounds of many species of fish. It would seem possible so to coordinate the two objects of retaining "fish-preserves" and providing lateral storage basins for flood waters as to promote simultaneously the conservation of fish and the prevention of floods.

In the irrigation fields of the west, it appears that there is not only a neglect of the possible advantages for fish life, but an unfortunate waste of the existing fish resources, owing to the want of suitable protecting screens in the irrigation laterals. The opportunities and the needs are not, however, unrecognized, and the subject receives serious consideration in some of the states concerned.

Stream pollution by sewage or industrial wastes has the closest re-

lation to fishery problems. Under some conditions a degree of stream pollution may prove distinctly favorable to the abundance of fish: in other cases it is unequivocally injurious. If the matter is one of significance to the fisheries, it is certainly true, on the other hand, that the problem of stream pollution, in its phases of ordinary interest, can not be studied to a definite conclusion except through analyses of the effects of the pollution upon the living aquatic organisms. This is to say, that the study of the sanitation of our streams involves the investigation of the effects upon fish or upon the organisms constituting the food of fish.

The dredging of channels and the construction of wing-dams as aids to navigation exert an unmistakable influence upon the distribution of fish and affect the fortunes of their existence in more or less obvious ways.

The conservation of water upon the farm remains for our consideration; but, if we may be permitted to draw a conclusion at this stage, it is this:— Whether we deal with head-water reservoirs for the regulation of stream flow, with water-power development and the incident pools, with reclamation or irrigation projects, with the dredging and damming for navigation purposes, or with stream pollution by any means, we find a vital relation to fishery problems and to fish-cultural operations. We find also a real necessity for the accumulation of a sufficient store of knowledge regarding the habits of fish, their requirements for feeding and breathing and breeding, and how these requirements are affected by the conditions that may prevail in our streams, lakes and ponds. We need, in short, an effective fishery science.

Water Storage and Fish Culture

We have already expressed the belief that the relation of fishery development to water conservation is not one of dependence only, but one of reciprocal benefits as well. It must be clear that we are speaking of development, not by protection, but by conservation of fish, with all that the term may imply. The word itself is unavoidably repeated frequently in such a discussion, because "conservation" alone seems to embody the whole thought of increase in supply along with development in utilization, as opposed to hoarding or restriction in use.

Could we think of an agriculture based upon protective measures? Could we imagine a modern nation dependent upon corn and cattle and poultry growing wild? Suppose a series of limitations for the perpetuation of crops and stock-yield, similar to the familiar measures for the preservation of fish or game; no scythe to have a blade more than 3 feet long, no individual to take more than 500 ears of corn per day, or to kill more than 10 pigs or 5 sheep or 2 cows per year. The very suggestion has a touch of absurdity: and yet such is the present

stage of our civilization or industrial life, as regards the utilization of fish. Not only may we question if this condition is permanent and inevitable, but we may be sure that the time will come when we will want fish to eat much more generally than now, and will get them by raising them in a larger way than is now done. We may have a familiar science of aquiculture just as we now have one of agriculture. It is interesting to note that, at the present time, there are sections of the country and classes of people for which fish forms a really staple food. This demand is so reflected in the commercial fishery that the coarser fishes, which, only a little while ago, were regarded as entirely superfluous or obnoxious, have become the mainstay of the commercial fishermen. It is still more interesting to observe that, among all classes of people, there is a noticeable awakening to the value of fish, and, concomitantly, a tendency to inquire if there is not some way to increase the supply of good table fish.

Let us now imagine that a great impetus could be given to the rearing of fish for table use as an occupation or as an adjunct to ordinary farming operations, until the fish pond were half as familiar as the poultry yard, and then let us inquire if there would be any effect upon the matter of water conservation.

The objects of flood prevention and navigation may be furthered in a temporary way by the construction of levees, by restriction of channels, and by dredging. All of these means are good; in fact they are essential for immediate relief; but the final accomplishment of the desired ends must be sought in the regulation of the flow of the rivers, and this undoubtedly will come about through the conservation of water at the sources. We sometimes think of this as being possible of attainment only by the construction of large artificial storage reservoirs at enormous expense, and often such a plan is called impracticable. Leaving that question, as we must, to the engineer, we may look to other and smaller measures which are certainly not impracticable. Smaller measure, we say, but we know that the cumulative effect of innumerable small efforts may in the long run be vaster than that of more spectacular and expensive operations.

It is said that much can be accomplished by the proper methods of tilling the soil to prevent run-offs and to compel the filtration of the rainfall into the soil. We are told of large farms that are so worked as to prevent any water at all running off the farm, while at the same time increasing the productivity of the farm with its cultivated fields, grazing lands and forests.[3] The methods are said to be simple and inexpensive, but an inquiry into them is apart from our present purpose.

Besides increasing the absorbent qualities of the soil, there is something which almost every farmer can do, that relatively few now

[3] Wall, Judson G., *loc. cit.*

think worth while. He can make one or more ponds in which much of the surface water is caught and stored for the subsequent use of his animals, and he can stock this pond with fish for domestic use, or for the market.

On the one hand, what a considerable addition to the food supply of the country would be found in such productive ponds. We are told of the fabulous wealth represented by the American hen,[4] and so it may yet be with the American catfish, the buffalo-fish, the sunfishes, or the bass. There is much to indicate that one can raise fish with less trouble and with as much profit as one rears poultry.

On the other hand, if one third of the 6,000,000 American farms had one or more fish ponds, what an enormous amount of water might be temporarily stored in these. It would seem that a positive step of some value would have been taken to prevent the destructive floods, to make more uniform the flow of streams, and thus to better navigation and to keep the soil waste upon the farm. "A fish pond for every farm" might yet become the watch-word for every advocate of improved navigation, flood prevention and soil conservation.

Some Practical Steps

It should not be presumed that a fad is proposed or that a simple nostrum is advocated for the immediate accomplishment of nation-wide benefits. Avenues of progress may be opened without calling for a headlong plunge into them. The incline is upward and probably beset with a common number of obstacles and pitfalls. On the one hand, if fish conservation in public waters can be promoted by broader and more positive efforts than are now generally made, it is necessary that thought and investigation should be applied to distinguish with certainty the ways that are right from the ways that are wrong. On the other hand, if increase of fish through private enterprise is practicable and appropriate, the movement will be but faintly advanced by the mere waving of a banner or a summons to the line. The imprudent are easily induced, but in the field of industry, the better recruits are the wise who look for plans and specifications and consider costs and possible returns.

There are many persons now seriously interested in fish rearing and who want to start a fish pond, or, having one, to make it more productive. They ask for information as to the fish and the conditions; but, at the best, the practical data that government or states can give

[4] American poultry products alone are worth half a billion dollars a year: report of Secretary of Agriculture, D. F. Houston, as quoted in the *Review of Reviews*, March, 1915, p. 266. This figure is more than double that of the potato crop, and approaches the estimate of value of the wheat crop. With the product of 500 millions from domestic poultry, compare the few millions (about twelve) credited to fresh-water fisheries, and based almost entirely upon wild fish.

is meager as bearing upon the questions raised. Few efforts for public service would be so apt and so inexpensive in proportion to probable return as the systematic dissemination of information bearing upon fish farming: but the data must be based upon judicious and continued experiment under conditions such as would confront the prospective fish farmers.

Doubtless a great deal of experience has been gained by private persons with interest and initiative, but there has been lacking a clearing house. There are valuable bits of information isolated or scattered and wanting for complete fruitfulness the benefits of interchange of experience, coordination and compilation. It would be practical indeed if the persons interested in effective fishery development would form themselves into associations, limited in territory by the similarity of conditions and problems as well as by the requirements of distance. The advantages to be gained would be palpable; there would be not only a fruitful interchange of ideas and experience, but a more explicit definition of difficulties and problems, so that the public department whose responsibility is to serve would be enlightened as to the form of service required.

The present purpose is fulfilled if the meaning of fish conservation is made clearer, and if the science of fisheries has been related in an unmistakable way to the vital interests of our whole people. The fish conservationist should orient himself with reference to some of the multitudinous phases of human interests and endeavors, and it is equally desirable that his orientation should be understood. One may look far over a landscape with the feet yet firmly upon the ground. A distant goal is not usually to be reached except by a succession of well-ordered steps, but perhaps it is also true that the farther the vision extends, the more readily may the steps be well ordered to the desired end.

THE PROGRESS OF SCIENCE

THE REPUBLIC OF LETTERS AND OF SCIENCE

THE importance of maintaining good will between the scientific men and the men of letters of the different nations is so great that we are glad to have the opportunity of printing here the remarks made by Professor Heinrich Morf at the opening of his winter course at the University of Berlin. As translated for us by Miss Agatha Schurz, Professor Morf said:

"On the morning of the first day of August I closed these lectures on the history of French literature. All hope of preserving peace had not yet vanished at that hour, and I belonged to the optimists. My optimism, however, was put in the wrong by the course of events, and we are now living in a state of war.

"The terrible conflict of arms is also a conflict of minds. Who could pride himself—if, indeed, it were a matter of pride—on having preserved his perfect composure! Even those who are not directly involved in the strife of arms, the neutrals, take sides spiritually and morally. The whole world is divided and torn into two great hostile camps. The greater part of the Latin world is our enemy. The intellectual bridges which connect nations seem to have been shattered, and across the yawning abyss ugly and agitated words are flying back and forth. The worst civil war is raging in the *Republica litterarum*, in the domains of science and art, which at other times unite all mankind and make of them world-citizens of a *Civitas Dei*.

"But of that civil war of the world let us not speak here. We have met for a labor of peace. The appeal which we teachers of German universities sent out into a world torn by war begins with the words 'We professors at Germany's universities serve science and devote ourselves to a labor of peace.' As soon as your teacher has ascended this platform and has closed the door of this lecture-room to the outer world, we shall and must turn away our thoughts for an hour from that which day and night oppresses our hearts, and we must compel our minds to concentrate on scientific work. The passions of the day must not enter here: we will leave them behind us. Science demands of us this act of self-discipline and of self-control. Whoever does not feel capable of it will not be able to serve science or to enter into any close relation to her; he will remain unsatisfied even in this lecture-hall devoted to her service.

"I should like to speak to you here of the French culture of the past, just as I have always done since I first took upon myself, thirty-five years ago, this task in Bern, on the borderland of the French and German languages. At that time I referred to Goethe, as I do to-day; for he has taught us that, with sympathetic interest for the culture of the Latin peoples, may be combined a deep love for the Teutonic, for our own. For all these years I have spoken to German youth of these Latin subjects with a feeling born of respectful regard for what is foreign to us, and of love for what is our own. That they appreciate what I have done they have kindly proved to me, even in these dreadful days, when friendly notes from writers personally unknown to me have reached me from the western front, expressing grateful remembrance of the hours when they had here studied French culture with me.

"The purely scientific character of these lectures, therefore, will not be changed. I should like, as heretofore, to train your minds to a scientific mode

of thought, and to lead you to a dispassionate historical conception and judgment of things of the past of foreign lands. Scientific work of this kind does not separate, it unites; it teaches to understand and to discern, not to despise. While I am saying this to you, the figure of my teacher, Gaston Paris, appears before me. Those years of study, those fellow-students, arise before my mind, with which are connected indelible memories of distant days of my youth and of recent happy intercourse. You have often heard from me the names of these collaborators and investigators. I have often here expressed to you what our science owes them, for what I myself am indebted to them.

"Beyond the bloody struggle of the present looms the dominating personality of Gaston Paris. Gratefully I salute his spirit from this place. I have often acknowledged the deep decisive influence he has exercised upon me; the best that I can give you has been aroused in me by him. Listen to the words with which he, the man of thirty, reopened his lectures at the Collège de France in December, 1870, in besieged Paris, 'surrounded by the iron ring, which the German armies have closed about us.' After a short reference to the work of the last term and to the students who had followed the call to arms, and some of whom might be in the hostile army of the besiegers, he spoke of the scientific problems which even in these anxious hours, 'when the Fatherland claimed all our thoughts,' still had a right to be considered.

I do not believe that, on the whole, patriotism has anything to do with science. The lecture-room is no political platform. Whoever uses the lecture-room to defend or to attack anything that lies outside of its purely intellectual province diverts it from its true purpose. I advocate unconditionally and without reservation the doctrine that science must adopt as her only aim the search of truth—truth for her own sake, without troubling herself whether this truth may, if put into practise, have good or evil, regrettable or gratifying consequences. Whoever indulges in the slightest concealment, the most trifling change in the presentation of those facts which are objects of his research, or in the deductions which he draws therefrom—though led by patriotic, religious or even moral considerations—is not worthy of a place in the great laboratory to which honesty is a much more indispensable title than skill or cleverness.

If the studies pursued in common are so conceived and are carried on in this spirit in all civilized countries, then they will constitute a great Fatherland, high above all barriers of hostile nationalities, undefiled by war, unmenaced by conquerors, in which minds can find the refuge and union which the Civitas Dei offered them in other days.

"Thus a young French scientist, who was at the same time an ardent patriot, spoke to his hearers on December 8, 1870. I do not know if patriotism in Paris has found similar expression to-day. Time will show. But I wish to remind you to-day of the words of this strong and noble man, who combined in wonderful harmony loyalty to the soil and citizenship of the world—love of his country and love of truth. May his words not have been spoken in vain!

"The German student of Romance subjects finds the fields of his labors to a great extent covered with ruins. The blossoms which had promised fruit have been blighted. The fruit which seemed already garnered is destroyed. New life will surely blossom from these ruins, for nature wills it so, for the salvation of mankind. Wherever the ground is strewn with wreckage we shall again draw furrows and scatter seed, and those who come after us will gather the harvest. And Teutons and Latins will enjoy it in common. Without this faith in the power and the perpetuity of the *Civitas Dei* of science, I should not stand before you to-day as your teacher of Romance philology, and your guide through French literature of the eighteenth century, which domain we expect to explore during this winter term quietly and with steadfast purpose."

PROFESSOR ONNES AND THE LEIDEN LABORATORY OF PHYSICS

THE Franklin Institute has made the first awards of its Franklin medal, established last year by a gift from Mr. Samuel Insul, to Mr. Thomas Alva Edison and to Professor Heike Kamerlingh Onnes. Mr. Edison's great contributions to the applications of science are known to us all. It may be of interest to give some statement of the work of Professor Onnes and the Leiden Laboratory, taken from the report of the institute. At the present time it is well to remember the important contributions made to science by the smaller nations. It is certainly a remarkable fact that Holland should have more physicists of high distinction than the United States.

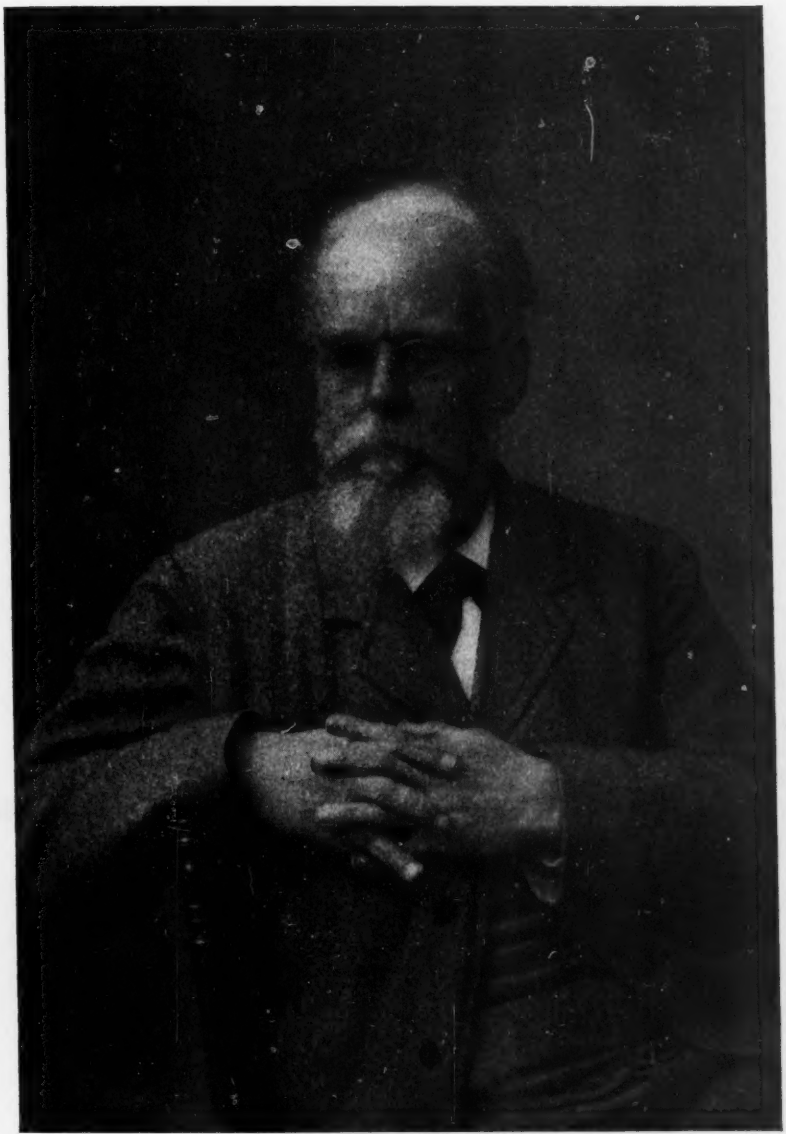
Heike Kamerlingh Onnes was born on September 21, 1853, at Groningen, Holland, where his father was engaged in manufacture. He was educated in the schools of his native town, and there also he began his university studies in 1870. Two years later he removed to Heidelberg, where he spent three semesters, working under the direction of Bunsen and Kirchoff. He then returned to Groningen, and a few years after he became assistant to Professor Bosscha at Delft, where he commenced work upon his thesis for the doctorate. In 1882 he and H. A. Lorentz were appointed professors of physics in the University of Leiden, then a little known and quite unpretentious seat of learning (so far as physical science was concerned), but which, as a result of the collaboration of these two highly-gifted young physicists, has become one of the world's great centers of physical research.

While Lorentz confined his energies mostly to the fields of theoretical and mathematical physics, Onnes directed his energies to the creation of a laboratory for experimental research. In spite of great obstacles, particularly of very inadequate appropriations for equipment and maintenance, the indefatigable director found ways and means of furnishing his laboratory with the special machinery and precision instruments required for the researches of the professors and their students. A very important—in fact, an essential—factor in this development was the establishment by Onnes of a training school for mechanicians, and it was in the shops of this school that many of the special instruments for the laboratory were constructed. At the same time the young men engaged there were trained to assist the director in carrying out the often difficult and intricate operations in his experimental work. On various occasions Professor Onnes was thus enabled to command a force of some thirty assistants, to each of whom a special duty was assigned.

The work of this great laboratory at Leiden is recorded in the *Leiden Communications*, published since 1891, and includes a vast number of most important contributions to physical science. Among them are investigations on magneto-electric effects, as well as a series of most important papers upon magneto-optical phenomena, such as the classical one by Zeeman, describing the discovery of what is now known as the Zeeman-effect. But, while these early investigations were all carried out under Onnes's direction, they were in many cases inspired or suggested by his distinguished colleague, H. A. Lorentz.

The really representative work of the laboratory has been in the field of molecular physics, and particularly in research at low temperature. The great bulk of the *Leiden Communications* is devoted to the records of those remarkable series of researches which were conceived by Onnes himself and carried out under his direction.

The history of these researches began with the creation of the cryogenic laboratory, and it may be divided into several distinct stages or periods. The first of these was occupied with the production of liquid oxygen on a large scale, and with the use of this material in a three-cycle process of obtaining



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AUGUST WEISMANN

The distinguished zoologist, late professor in the University of Freiburg, known especially for his contributions to the theory of heredity.

low temperatures, by which Onnes was enabled to maintain and control the temperature ranges from —23° to —90° (methyl chloride), from —105° to —165° (ethylene), and —183° to —217° (oxygen). This goal may be said to have been attained about 1894. The second stage was characterized by the introduction of liquid hydrogen and the production of temperatures below —217°. The abnormal behavior of hydrogen gas when it is allowed to expand under reduced pressures made it impossible to liquefy it at higher temperatures; and the condensation of this gas was first achieved by Dewar, of London, on May 10, 1898. This added a new range of available low temperatures from —253° to —250° in which Dewar made a number of highly remarkable observations, including the solidification of hydrogen. But Onnes very promptly appropriated this new range for his research work, and constructed novel and very efficient apparatus for the production and utilization of the new refrigerant.

The Netherlands government, realizing the importance of the work, now granted considerable appropriations for the extension and equipment of the laboratory, and with its completion a new era of constantly increasing low temperature research began. New methods and instruments for the exact measurement of temperatures below the boiling-point of liquid hydrogen were devised, and the behavior of mixtures of hydrogen and helium was systematically investigated. Finally, the apparently incoercible gas, helium, was reduced to the liquid state. This crowning triumph of low temperature research was achieved on July 10, 1908. This achievement aroused universal interest in the work of Onnes and doubtless prompted the award to him, in 1913, of the Nobel Prize in Physics.

During the past few years Onnes has made some most remarkable discoveries with reference to the electrical resistance of certain metals at temperatures only a few degrees above the absolute zero of temperature. The resistance of metals ordinarily varies approximately with the absolute temperature, but at temperatures only a few degrees above the absolute zero it suddenly becomes so small that it can hardly be measured. For mercury this "critical temperature" is 4.2° absolute; for lead it is 6.1°, and for tin 3.8°. Below these temperatures the resistance is practically *nil*, and Onnes terms this the "supraconductive" state. In this state the metals no longer obey Ohm's law—there is neither a potential drop nor a production of heat.

SCIENTIFIC ITEMS

We record with regret the deaths of Joseph Johnston Hardy, professor of mathematics and astronomy at Lafayette College; of Dr. Samuel Baldwin Ward, since 1884 dean of the Albany Medical College and professor of the theory and practise of medicine, and of James Blaine Miller, of the Coast and Geodetic Survey, a passenger on the *Lusitania*.

The Barnard gold medal awarded every fifth year by Columbia University, on the recommendation of the National Academy of Sciences, "to that person who, within the five years next preceding, made such discovery in physical or astronomical science, or such novel application of science to purposes beneficial to the human race, as may be deemed by the National Academy of Sciences most worthy of the honor," will be given this year to William H. Bragg, D.Sc., F.R.S., Cavendish professor of physics in the University of Leeds, and to his son, W. L. Bragg, of the University of Cambridge, for their researches in molecular physics and in the particular field of radio-activity. The previous awards of the Barnard medal have been made as follows: 1895—Lord Rayleigh and Professor William Ramsay; 1900—Professor Wilhelm Conrad von Röntgen; 1905—Professor Henri Becquerel; 1910—Professor Ernest Rutherford.